This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

+ *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.

+ *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.

+ *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.

+ *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at `http://books.google.com/`

ECONOMY OF NATURE

J. G. MACVICAR. D.D.

ELEMENTS

OF THE

ECONOMY OF NATURE.

(A FRAGMENT.)

BY J. G. MACVICAR, D.D.,

AUTHOR OF "THE PHILOSOPHY OF THE BEAUTIFUL;" "AN INQUIRY INTO HUMAN NATURE;"
"THE CATHOLIC SPIRIT OF TRUE RELIGION."

Αριστα ὦ Τίμαιε.
PLAT. *in Tim.*

SECOND EDITION.

LONDON:
CHAPMAN AND HALL, PICCADILLY.

MDCCCLVI.

198. a. 19.

"I say, then, in short, that, in an opinion, I look upon its being new or ancient, and its being singular or commonly received, as things that are but extrinsic to its being true or false; and, as I would never reject a truth for being generally known or received, so will I not conclude an opinion to be a truth for being generally known or received, merely because great numbers have thought it to be so, nor think an opinion erroneous, because it is not yet known to many, or because it opposes a tenet embraced by many. For I am wont to judge of opinions as of coins. I consider much less, in any one that I am to receive, whose inscription it bears, than what metal it is made of. It is indifferent enough to me, whether it was stamped many years or ages since, or came but yesterday from the mint. Nor do I regard through how many or how few hands it has passed for current, provided I know by the touchstone, or any such trial, purposely made, whether or no it be genuine, and does or does not deserve to have been current; for if, upon due proof, it appears to be good, its having been long and by many received for such, will not tempt me to refuse it. But if I find it counterfeit, neither the prince's image or inscription, nor its date (how ancient soever), nor the multitude of hands through which it has passed unsuspected, will engage me to receive it; and, one disavowing trial, well made, will much more discredit with me than all those specious things I have named can recommend."—BOYLE.

PREFACE.

The first edition of this work was published in 1830, and has now almost entirely disappeared. Nor is this to be regretted, for it was prematurely published. During the quarter of a century which has elapsed since then, however, the author has had very favourable opportunities (in a retreat in the Island of Ceylon) of pursuing his researches, and of testing and developing his views, until now that an engrossment with professional engagements of quite another kind, are fast driving his most cherished conceptions and results in this field, quite out of his head. Not being able to consent to lose what, to himself at least, has ultimately proved so instructive, and what he cannot but believe will have its place in the future, though probably not in connection with a name so obscure as his own, he has compressed, in the few pages which follow, the heads of his method and his principal results—the work no better than a mere skeleton, it must be confessed, but all the fitter, on that account, perhaps, for the fate which immediate awaits it, and, at any rate, all the less costly.

The Author, for a long time, cherished the hope of leisure sufficient to enable him to proceed with the construction of the diagrams of organic molecules, until, before he closed his labours, he might have reached that of some tissue or other. This point gained, the conditions of health, and the most probable forms of disease, of cure, and of prevention (so far as that tissue was concerned), would have immediately declared themselves; and his work, if in any measure true to nature, would have been immediately available for the relief of suffering. But organic molecules, even when their formulæ are the same, prove to be so polymorphous, and the methods at present in use in the laboratory are so liable to give halves and doubles instead of the true weights of molecules, that the inquiry is one of extreme labour and difficulty. It requires the concurrence of many minds, or at least the stimulus of social regard for its successful pursuit. At all events, except in some hurried notices worthy of but little confidence, this the most interesting of all possible problems in material nature, has not been even approached in what follows. The Author cannot help thinking, however, that there are men of such genius all over Europe now devoted to chemical research, that the structure of some tissue or other would not be long in being reached, if the right method of research were taken, and the accurate logic and vast synthetic power of positive geometry substituted for the vague Pythagoreanism that prevails, which, while declining that name, would itself undoubtedly be disowned by the Philosopher of Samos.

The Third Part, which embraces the subject of Psychology, still remains in MS., since it is more kindred to the author's present duties, and does not run the same risk of being lost and forgotten. It consists in the exposition of all the principal phenomena of mind by reference to THE THREE LAWS OF BEING developed here in Chapter III., as the sole determining causes of their form; and it will be published as soon as there is the prospect of a few thoughtful favourably disposed readers.

The author deeply regrets, that the existence of a first edition, binds him to a Title which he feels to be presumptuous and offensive, and which he has attempted to qualify.

The philosophical chemist, after perusing the pages now in his hands, will perhaps not be unthankful for the Table on page viii., which should have been thought of sooner. A second Table would also have been desirable, presenting the same agents in positions expressive of their mutual relationships. But these are so manifold, as to render the construction of such a table (especially on a plane such as a page of paper) a matter of very great difficulty.

MANSE OF MOFFAT, DUMFRIESSHIRE,
March 1856.

CONTENTS.

PART I.

PAGE

CHAP. I. On Method.—The aim of Science what?—An Explanation what? Conditions of a full Explanation.—Not possible to man.—Explanation by law good.—Law cannot be a last word to Philosophy, but God the author of all. —Miracle.— Law and Miracle equally from God.—Creation.—Power, Unity, Immutability, to be looked for in its first elements.—No construction *à priori* to be attempted.—The Senses to be supplemented by Reason.—The danger of Hypotheses.—The basis of Philosophy is Religion, . . 1-6

CHAP. II. The Medium of Light.—The error of the Eleatic School—of Modern Materialism.—Strange state of Chemical theory.—Hope of something better.—Heraclitus and Faraday.—A mother element.—The medium of light is—In the middle ground between the spiritual and the material.—May supply substançe for both worlds.—The ætherial elements, what?—May be called Elementary Forces.—Are the minima Naturæ.—May be united in either of two ways.—Psychical Beings and Material Masses, 6-17

CHAP. III. Of Created Being and its Laws. Being = Power.—Laws of Created Being. Law I.—The Permanency of Species. Law II.—Universal Sociality and Attraction. Law III.—Universal Assimilation and Harmony. —These Laws co-extensive with Creation, and determine the phenomena equally of the Intellectual, the Moral, and the Material sphere.—Psychology must be postponed, ... 17-21

PART II.

CHAP. I. The First Lines of Morphology.—The Laws of Form and Structure. Regeneration, Union, Solution, Polarity, Symmetry, Sphericity, 21-24

CHAP. II. The Properties of Matter.—The Ætherial Atom a Centre of Force, invested by an insulative atmosphere.—Whose nature is inscrutable. —But is Calorific.—The minima of Bodies are perfectly elastic and impenetrable.—But dissimilar Molecules are mutually penetrable or dielastic.— Interferences, Diffusion, and Osmose.—Union.—The mode of that union determinate—as also, Atomic Volume, ... 24-32

CHAP. III. The General Forms of Molecules.—Heteropolar Molecules.— Homopolar.—Isometrical.—The Icosatom and the Tetratom.—The Dodecatom and the Triatom.—Homogonal Molecules, ... 33-35

ELEMENTS

OF THE

ECONOMY OF NATURE.

(A FRAGMENT.)

BY J. G. MACVICAR, D.D.,

AUTHOR OF "THE PHILOSOPHY OF THE BEAUTIFUL;" "AN INQUIRY INTO HUMAN NATURE;"
"THE CATHOLIC SPIRIT OF TRUE RELIGION."

Αϱιστα ῶ Τίμαιε.
Plat. *in Tim.*

SECOND EDITION.

LONDON:
CHAPMAN AND HALL, PICCADILLY.

MDCCCLVI.

198. a. 19.

sophy. Law is a rule or mode of action laid down by intelligence to be obeyed and realised by a being or thing which has power or aptitude to do so. Although, therefore, the phenomena of nature may have been referred to law, and explained in this way, they are not finally disposed of when this has been done. They are only handed over to the domain of intelligence. They are only confessed to be under the rule of intelligence. The *material* is placed in subordination to the *spiritual;* and grant or give an explanation by law of the phenomena of nature, it is granted at the same time that in the spiritual world, not in the material, the last word of philosophy is to be found. And those who practise explanation by law, while yet they fail or refuse to recognise an antecedent Intelligence possessing power to make laws, do not use the term law legitimately. They use it not scientifically, but merely poetically or else surreptitiously; yet not poetically—for the denial of spirit renders all poetry impossible—and therefore they use it surreptitiously, not by design, perhaps, but by fashion, and as usual for the sake of popularity; for explanation of the phenomena of nature by law must always be popular in natural science, and will pass for satisfactory with men in general, no less than the same doctrine in the social sciences.

7. *But God the Author of all.*—Reason knows in her own right, and all men believe naturally though confusedly that A SPIRITUAL WORLD IS THE FOUNTAIN OF THE MATERIAL, AND THAT GOD IS THE AUTHOR OF ALL. Reason, therefore, and men in general, accept gladly explanation by law, though here and there a sophisticated mind limits the import of the term when so used.

8. *An opening must also be kept for Miracles.*—Explanation by law must also be accepted under another limitation. There exists in the universe free power. Consciousness bears witness to it in Self. And its existence either in Self or anywhere it is impossible to explain, or to satisfy the demands of reason anyhow, without admitting that free power exists in perfection in Him who is the Author of all—God—in whom it has just been seen that philosophy must find its last word, in so far as the study of phenomena is regarded as the study of laws. Now, of a free Power the characteristic is to originate acts which may be both new and singular, and under no law but that of liberty. Such acts, therefore, and phenomena expressive of them, we are to expect in nature if nature be fully a manifestation of its Author. Yet, this under two conditions:—*First*, we are to expect them sparingly: for if in His ordinary providence the Creator put forth his free power from day to day in accomplishing new and singular acts, there would be no place for wisdom in man; experience would only deceive; forethought would be folly; and all science would be impossible. Whilst, therefore, philosophy leads us to regard the occurrence of such new and singular acts of the free power of God, as necessary in order to render creation fully expressive of the Creator, it leads us also to expect them but rarely; and, therefore, to find them bearing some name expressive at once of their rarity and singularity, such as the term "miracle," which has now supplanted every other, though it be

of merely subjective import, and every way inferior to such a term as "sign."

9. *Law and Miracle are equally products of God's Essential Attributes.*—But, as of all laws, so of all miracles, it is to be uniformly held, whatever their singularity, when viewed in reference to the ordinary course of nature, that they can never contradict the essential attributes of Him who is their Author. Within the compass of these attributes the whole of creation—that which is miracle as well as that which proceeds uniformly and by law—must be included. And on this we build our method so far as it differs from the popular method, commonly called the inductive. Availing ourselves of what all believe, who believe in God at all, it becomes possible, by a reference to the doctrine of causation, to obtain information as to nature just where observation fails, and where light from some other source is needed.

10. *Creation must be expressive of God's Essential Attributes.*—Thus it forms our very conception of the relation of cause and effect, that an immediate effect shall contain or be impressed by the characteristics or attributes of the cause which produced it. Nature, therefore, if God be its Author and cause, must, at least in those primary elements to which He, by an immediate forthputting of his will or power, awarded existence, be impressed or sealed by his essential or ontological characteristics or attributes, in so far at least, as it belongs to creation, as an effect, to receive and bear the impress of the Creator as its cause. And hence, since the essential attributes of God are among the most certain of all truths, being given by pure reason itself, we may, to a certain extent, proceed from the Creator to the creation, as in the ordinary course of legitimate discovery; that is, FROM THE KNOWN TO THE UNKNOWN.

11. *Power, Unity, Immutability, to be looked for in its First Elements.*—By universal consent it is agreed that, in the Author of all—the Being of beings, the Cause of causes—these attributes exist, and that in perfection,—

1. Power.
2. Unity.
3. Immutability.

} Intelligence.

These, therefore, though in finite measure, we may expect to be impressed upon the first elements of creation, and to characterize them. And now, therefore, adopting the history of philosophy as the summary of what observation has given to mankind, let us search and see whether it be not possible to find, by the aid of this principle of choice, from the most remote antiquity all down the stream of time, a theory of nature which will explain the various phenomena with which modern science is conversant.

12. *No Construction a priori should be attempted.*—To history, to biography, to testimony, to the use of the senses, at all events. we must have recourse. It is not possible that, by any process of reasoning, independent of observation, the transition can ever be made from the Creator to the creation—from God to those works of His which

actually exist in detail. The worlds which an infinite Intelligence may create are themselves infinite. God, considered in his Intelligence, is the Creator, not merely of this world, but of all possible worlds; for all possible worlds necessarily present themselves in the infinite perceptivity of the Divine mind when any one is thought of. Before existence could have been awarded to an actual world, such as this of ours, there must have been in the creative mind an engagement of some other attribute than mere intellect; for this world of ours is a dynamical system, to say the least of it. This world embodies power, or has power in it; and, before existence could have been awarded to it, there must have been a forthputting of power by God. But, in God, who is at once omnipotent and intelligent, power and will must mean the same thing. In the creation of the world, therefore, there must have been the forthputting of the Divine, the Almighty will. But the movements of an almighty will are essentially free. They are, therefore, in their very nature, not deducible by man. Never by dint of mere reasoning can we possibly ascend to the discovery of particular volitions in God; and, therefore, never to the discovery of a particular creation. It might, perhaps, be said that, by an adequate Intelligence, all possible creations are discoverable, if eternity were allowed as the time for discovery. But, as to any one actual world, the product of the free will of an Almighty Being, even though its contents amounted to no more than a single star, nay, a single atom, it is absolutely impossible for the highest archangel, nay, for another God, if there were more than one, to discover the form and potencies of that atom, otherwise than by being allowed to observe them, or to listen when he was told them. The will of every individual, in its very nature, keeps the intelligence of another at a great distance from its particular volitions; and the will of God, inasmuch as it is absolute and almighty, and is, in an equal degree, the fountain of all possible worlds, is absolutely unsearchable and private, until he is himself pleased to manifest or make it known; and, therefore, any actual world, as, for instance, this that we belong to, must be given—must be laid down before us—ere it possibly can be known. It cannot be reasoned out. The conditions of its existence render a transcendental method of discovery wholly impracticable. Say that the principles of optimism are sound, still they can give no positive results in Physics. They are of avail only in Theodicy. Our method gives us a standing-place from which to investigate and observe the actual, but not an organon available for the construction of the actual. It does not give an eye, it only directs that eye which God has given. It is, indeed, rather a principle of criticism than of discovery. Yet it is not an unimportant principle. It is, on the contrary, one which, to us at least, appears to be indispensable to the restoration of science to the dignity of philosophy, from which, in all except in name, it has of late so sadly fallen.

13. *But the Senses require to be Supplemented by Reason.*—Very much has, indeed, been written, especially in the English language, with a new to persuade the public that the true and only safe method of in-

terpreting nature is purely observational and inferential, and neither needs the lights nor runs the risks of building in any measure on the original or *a priori* contents of reason or intelligence. We are almost everywhere told, that whatever is concluded from an observation, if it is not contained in that observation, and merely obtained from it as a generalisation, is not legitimate, and ought to be repudiated. All besides is characterized as hypothesis, a term to which a stigma is attached. But, with all its logical beauty, such a conception of a purely observational method is nothing better than that which it condemns. It is nothing better than a mere hypothesis. It has never yet been acted upon, nor, indeed, ever can be. "The soul that rises in us our life's star" is quicker than the prison house which is appointed to confine it for a time. The mind moves faster than the muscles. Even the eye lags behind the thought; and its highest office is to be the fag of the will. Hypotheses are imminent in a mind placed as ours is in darkness. They are unavoidable. They are necessary. Observation, experiment, travel, all that is commended in our day, there ought to be, there must be, and the more the better. But the pure analysis of a phenomenon, along one straight unbroken line of observation, is utterly impracticable by man. For one thing in an object that is seen, there are ten that lie concealed, or pass unobserved. And even though all that are there could be seen, man has not logical power enough to digest them, without borrowing from the contents of reason. The logical powers, even when aided by all the perfectionments of the calculus, begin to fail, when as yet there are even no more than three separate elements or considerations in the problem to be solved, while the simplest phenomenon of nature involves at least a score. There must be hypotheses in science, as there always have been, and are now, in this age of their formal repudiation—more, perhaps, than there ever were before.

14. *The Danger of Hypotheses.*—It is not the mere existence of hypotheses that is to be deplored, but it is the facility of their construction and their pretensions in undisciplined minds. One may form them by the dozen in a forenoon and not be much exhausted after all. And yet no sooner is one formed by an undisciplined mind than it proceeds to take possession of the field of inquiry, and to urge its claims to belief with all the warmth that would be due to the actual voice of nature, were she to repeat herself legitimately by way of echo in the observer's soul. Hence the danger of hypotheses. And hence the value of any method which, while it allows what cannot be prevented, has also the means of controlling hypotheses, and of rejecting them by exclusion ultimately all save one. And such do I conceive that method in good measure to be, which views nature not merely as a phenomenon or aggregate of phenomena, but as a product, a creation having for its Author and Cause a Being of whom power, unity, and immutability, along with intelligence in perfection, are characteristics or attributes.

15. *Apology for Laying the Basis of Philosophy in Religion.*—Is it said, that in grounding upon the existence of an intelligent Author of

nature, I am building my entire superstructure upon that which is of all things the most difficult to be granted, I answer the objector, whatever his views in theology, that still I am free to postulate it, if progress be impossible without it, and that he ought to grant it to me at least, as "an unknown" or symbol. For this, I quote the practice of the mathematician as a precedent. Of all reasoners the mathematician is the least faulty; and as he, by laying down for his construction something which is at first merely useful, is often able, by considering the conditions of the problem to be solved, to light it up into a reality of a definite value, so may not I, with the leave of all, whether believers in God or not, assume the name and attributes of God, if I find them necessary or even useful? Perhaps to him who is at present no believer, the result of our inquiry may be to light that name up into a reality; which, could that only be done, it were of comparatively little consequence whether anything else in this volume were accepted; for certainly the first and the indispensable condition to the well-being of man is, that his heart be right with his God; as that of the well-being of philosophy is, that it find both its first and its last words, its Sabbath and Haven in God.

CHAPTER II.

THE MEDIUM OF LIGHT.

16. *The Error of the Eleatic School.*—The method which we propose consists in the equal use and friendly co-operation of reason and of the senses. And here let us notice two systems of philosophy, the one great in ancient times, the other great in our own, which owe their existence to the disruption of this method, and the adoption in the one case of reason as the sole informer, in the other case, of the senses. By one school in ancient Greece the senses were disparaged, and reason alone held to be trustworthy in laying the grounds of science. And hence, the disciples of this school were thrown into conceptions of power, immutability, and unity, from which they could not again emancipate themselves. The descent from unity to multiplicity, and consequently from God to nature, was found to be impossible, and thus there opened up the sublime abyss of the Eleatic school—so often reproduced under a variety of forms in later and even in modern times.

17. *The Error of Modern Materialism.*—In other days, and by other schools again, the informations of the senses alone are listened to, and then men of science become so impressed by the fact of the multiplicity and variety, which nature exhibits on all hands, that the conception of an original identity in the first elements of nature, proves distasteful; and when they think of carrying up their thoughts from the

material to the spiritual, from nature to God, there appears to be between them a great gulph fixed, which it seems as if even Providence could not pass over. God appears to be so isolated and disconnected with all besides, that He is easily forgotten, disregarded, denied. All is held to be material, mechanical, fatal. The term law is retained in discourses upon nature only surreptitiously, for science has denied its legitimacy. And such is the nowise sublime abyss of the materialistic school of the nineteenth century, that which unhappily rules in physical science amongst us.

18. *The Strange State of Chemical Theory.*—Corresponding to this state of things in philosophy, there is also in the molecular science of the day the holding of multiplicity up to the extent of maintaining, that instead of one primary element, there are some sixty elements, respecting which it is believed, that although they all agree in being heavy, extended, molecular, and actuated by attractive and repulsive forces of the very same kinds, yet are they so absolutely different and distinct from each other, that in no circumstances whatever, not in the lapse of millions of ages, not under any possible changes of prolonged action or of temperature, is it possible for any transmutation to take place among them! In a few chemical works we do indeed meet with cautions as to holding these sixty substances to be elementary on some such grounds as, that the only evidence we have that they are elementary, is the accident that the chemist of the present year cannot decompose them, from which, certainly, it by no means follows, that the chemist of the year 2000 shall not decompose them, nor that nature may not have been decomposing and recomposing them from the beginning of time, even as she has been swinging the planet Jupiter round the sun, a feat for which the chemist of the present year is by no means equal. It may be even said, that in the most recent and respectable chemical works, the possible decomposability of the greater part, if not all the elements except hydrogen, is insinuated. But this is only said as a saving clause. Woe to the young chemist who would venture a step farther. And if any geologist should dare to hint that what is now silica, may (although many millions of ages ago), have been alumina, or any thing else but silica for ever, not even the good name of a Sir Charles or a Sir Roderick could save him. It is positively laid down as the alone authorised ground of scientific speculation in our day, that the material system is composed of a multiplicity of elements of unknown multitude, but of which there are some sixty, more or less, in our little planet, which, from the beginning of time, or haply, from all eternity, have been each one of them just what they are now! There is nothing in the *quicunque vult* of the ancient church respecting the spiritual world, which is laid down more dogmatically, or with sorer penalties on misbelief, than is this in modern science.

19. *There is a hope of Something Better.*—Scotland, always heretical, has indeed been backward to believe, and forward to break off from this doctrine, otherwise catholic. T. Thomson (who is to Scotland in the chemical sciences what T. Reid is in the intellectual), in

his review of the opinions of philosophers respecting the ultimate elements of bodies (First Principles, p. 80), after noticing the opinion prevalent in the eighteenth century, that matter was even physically divisible, *ad infinitum*, goes on to say: "Leibnitz, on the other hand, adopted the opinion, that the ultimate elements of bodies are atoms, and to obviate the mathematical objections of those who had embraced the doctrine of the infinite divisibility of matter, he considered these atoms as unextended;" and after showing how this was followed up by Boscovich, the Scottish chemist says: "With respect to the notion entertained by Boscovich, that the ultimate atoms of bodies are homogeneous, we are incapable of deciding whether it be well or ill founded. It is not likely that any of these ultimate elements has ever come under our inspection. All our simple bodies are most probably compounds. It is possible that the ultimate elements of bodies may be very few." And since the time when these words were published, other Scottish philosophers have affirmed this view more positively. But that only for their own misery. The voice of the chemical world, upon the whole, is this: "We will make no change in our belief in the sixty, but in our laboratories at the instance of our own eyes, as witnesses of a transmutation of elements actually accomplished." Now this is all very well, if chemists, when saying so, are content to regard their pursuit as an art merely, and not a science, as indeed chemistry was in its rise, and was long held to be. But if chemistry is to have the rank assigned to it of a science of nature, surely the logic of the laboratory must enlarge itself a little. Not but that Protagoras and his fellow sophists, in the age of Pericles, did indeed maintain that man was the measure of all things. But it may be fairly questioned, whether Protagoras ever dreamed in his philosophy of such a product of it as this, that because at a certain moment of time, viz., this particular day of ours, philosophers can hold the tongs and blow the fire, neither better nor worse, but just so well as to give, say just fifty-nine or sixty-three different substances which he cannot at this particular moment resolve into others, therefore these fifty-nine or sixty-three are the very elements out of which the material universe is composed; and in all speculations as to the origin and subsequent history of our planet, we are safe in taking for granted that the fifty-nine or sixty-three have always been just as the chemist of the present day fancies or finds them to be! Protagoras, we think, would have been startled at so bold an inference, and if it had been proposed for his belief, would have made a step towards Pyrrho, and have called for a suspension of the judgment on such a dogma.

20. *Heraclitus and Faraday.*—Especially if, as is likely, he was acquainted with the magnificent conception of Heraclitus, that all nature is in a ῥοὴ or current pursuing two parallel but opposite courses; that of the ὅδη κάτω, which gives substances of still increasing density from elemental fire down to the most solid concretes; and that of the ἄν ὅδη, which takes up the concrete products of the όδη κάτω, and while carrying them onward in the course of nature resolves them into lighter substances, and delivers them up at last as elemental fire, again to

enter anew and again to make the beautiful tour of nature. Marvellous anticipation this surely, of Heraclitus, and that on the grandest scale, of the most improved conceptions of our own times as to the form of the forces, by which the course of nature is wrought out and sustained, nay, even of the technical terms which have been invented only the other day by the most gifted of living physicists, to express it! for the *ὁδη κάτω* and the *ἄνόδη* of Heraclitus, what are they in English but the catode and the anode of Faraday? Nor is the agreement verbal merely. The conception of the ancient Greek is that of two grand forces in nature, the one (the anode) sublimating matter, the other (the cathode) condensing and solidifying it. Now, while the force of polarity has of late been shown to extend all through nature, it forms one of the finest discoveries connected with the galvanic current that caloric, that is, the force whose special function is to vaporise or sublimate, is poured forth at one pole, while the other remains cold and suitable for condensation, thus realising the conception of the dark Ephesian in such an early age, as to invite to the inference, that surely science as well as religion has its prophets.

21. *Reason leads us to anticipate a Mother Element.*—But to apply our method, and to make progress, thankful that the doctrine of a multiplicity of elements is now in its grand climactric, for there seem to be just sixty-three elements, let us remark, in opposition to it, that the only conception which satisfies reason without being displeasing to the senses, as to the ground of physical science, is that the mundane system has for its basis and material, some one kind of substance very much divided though not infinitely divisible. To argue this point is unnecessary, because every one of philosophical habits of thought, feels at once that in order to construct a pure science, and to get rid of collateral hypotheses for ever intruding themselves as we proceed, the original data or postulates ought, if possible, to be homogeneous. And of this state of things the most eligible condition obtains, when these homogeneous data or postulates are also all identical, or the duplicates of each other differing only in their relations in space and time. Now, to such a condition of the universe, when viewed at the fountainhead, our method leads us; for as that method regards nature as the creation (or product at once in difference and agreement) of One almighty, immutable, identical Being, it leads us to the conception of a mother element which shall manifest multiplicity to the utmost, and yet be one as a whole, that whole composed in detail of parts or particles, all of which shall be identical and immutable. But for a reason which has been already assigned (12), let us not attempt to deduce the elements of creation, by reasoning—let us rather appeal to observation, which is alone safe.

22. *Hydrogen is not the Mother Element.*—What then, of all things which fall within the range of our observation, looks as if it were the first of created things, the most immediate product of the Divine power? Or to put the question in a form more in keeping with the fashion and spirit of our times, What in the last analysis do we arrive at as the substance or medium in which matter seems to find its limit

on the side of tenuity, or if you will—of zero? To this, the chemist is plainly disposed to answer that it is hydrogen gas. Great pains have long ago been taken in England, and more lately on the Continent, to ascertain whether the equivalents of all bodies be not multiples of hydrogen—an inquiry which plainly points to some such conception as that the atoms of all other bodies may possibly consist of undecomposable molecules of hydrogen grouped together. But it has been, by no means proved, that the equivalent of hydrogen is related to the equivalents of other bodies in this way. It measures many other equivalents, but not all. Nor is there any such pre-eminence in the position of hydrogen in nature as would invite or even justify us in selecting it as the grand element of nature. Hydrogen is, indeed, the lightest of all the ponderable bodies of the laboratory; but nature, instead of presenting this substance to us as the mother element, almost declines to present it to us at all. Nowhere in the repose of nature does free hydrogen exist. In the volcano and the laboratory of the chemist alone is it to be found; and there, when free or alone, instead of appearing as a primal or genetic element, it always appears as a product or educt of another substance, viz., water, whence also, to all appearance, both plants and animals have it. In a word, wherever hydrogen makes its apparition in nature, there is evidence that water has been before it. Into water also it reverts, as often as it meets either in the nascent or in the fiery state with oxygen.

In opposition to such views, it will no doubt be said that hydrogen forms a ninth part of the entire ocean, and of all waters; and that the quantity of it in permanence on the terraqueous globe, therefore, is immense. But, in such an inquiry as we are now entering upon, the most accurate limitation and adjustment of inference to evidence is indispensable. And when this is done in the present case, it will be found that it is only popularly, and not with logical accuracy that the affirmation can be made, that either hydrogen or oxygen exists in water. What there is evidence for is this, but for nothing more, that water may, in certain circumstances, be changed in hydrogen and oxygen; and *vice versa* that in other circumstances hydrogen and oxygen may be changed into water. It is fully ascertained in the natural or chemical history of an atom or element of water, that at one moment it is an element of water, the next, oxygen and hydrogen, and the next, an element of water again, and so on, to any number of successions that the chemist pleases. But this is all that has been ascertained; and the discovery is such that the successiveness of the phenomena is one of their essential features. There is no evidence that the liquid element is oxygen and hydrogen (as known when separate) united, at the same time that it is water, but much against such an inference. And unless it be the aim of science to excite (as it really is to eliminate) wonder, their identity should not be lightly affirmed. Taking AQ as a symbol for an element of water, all that has been proved by chemistry is that AQ=HO, not that AQ is HO. It has only been proved that when AQ disappears, HO appears, and when HO disappears AQ appears. To affirm on the evidence we possess, that AQ is HO, or that HO is AQ, is much more unwarrantable than it would be to affirm, under the first proposition of mechanics, that the diagonal in the parallelogram of forces is the two lateral forces into which it may be resolved, or of which it may be the resultant. If, indeed, a butterfly could revert into a caterpillar, as a caterpillar rises into a butterfly, to affirm that AQ is HO, is almost if not quite as bad as it would be to affirm that a caterpillar is a butterfly. Not the verb *is*, but *becomes*, is that which the evidence sanctions. It is certain that the same matter may be obtained either as AQ or as HO. But everything indicates that AQ and HO are different forms of the same matter. And upon the whole, the claims of hydrogen to be regarded as the grand element of the material economy are very slender. But if not hydrogen, what then?

23. *The Medium of Light is the Mother Element.*—Leaving the favourite of the chemist, it may, in answer to the question, What is the mother element? be affirmed that the deep thinking memorable men of all ages and nations, from the venerable poets and philosophers of ancient Asia and Greece, down to our own contemporaries (who may be said to be unanimous on this point), hold out to us as the finest of things, and that in the visible world which touches the spiritual, or, if you will, the zero, most nearly, a universal æther, the medium of light. So nearly, indeed, does the ætherial appear to touch on the spiritual, that, perhaps it may be said of it that by no observer of note has it ever been affirmed to be simply material, while by many it has been held to be spiritual, and even divine. It was the original Zeus of the ancient Greek, the foremost object in his thoughts, down to the age of Zeno, while to our own great poet it was no less than the power addressed by him as—

> "Offspring of Heaven first-born,
> Or of the eternal coeternal beam,
> May I express them unblamed."

Only a few moderns have resisted the æther, and that chiefly from a concern for the stars. They have been altogether averse to admit the existence of anything into the celestial spaces, lest it should stop the planets in their orbits. But light—the medium of light—is there at all events, and cannot be got rid of. And this fact surely ought to calm their apprehensions, especially when it is considered that no inference whatever can be legitimately drawn, as to the effect, upon the planetary motions of a medium in which they are destined to move, unless the structure of that medium is given along with its existence. This the recently discovered phenomena of electro-magnetism fully warrant us in affirming; and, indeed, without the aid of such new lights, or of more refined observations than those of the mountain shepherd, or the back-woodsman, who may have watched the progress of a blaze on the heath or in the forest; for they have often seen that instead of being resisted or driven to leeward by the wind, the fire keeps rushing up towards the wind's eye—the inertia of the air being less powerful to stop than its chemical power to urge the flame to motion. The æther, far from necessarily obstructing or retarding the planets, may be imagined to be of such a structure as shall both rotate and revolve them. But with such points we have nothing to do here, nor need we dwell longer on the astronomical difficulty implied in the existence of an æther, since it may be safely stated to be now the general creed of men of science, that an æther does exist, and that the planets must take their chance.

24. *This Medium exists on the Middle Ground between the Spiritual and the Material.*—And may we not add, that light is generally allowed to be intermediate in its nature between spirit and body according to the popular conception of these two classes of beings. Thus, on the one hand, its elements are affirmed to be imponderable, and, therefore, so far at least in relation with spirit; while yet, on the other, they are affirmed to possess inertia, and, therefore, so far at least, in relation with body. As to their elasticity, which is generally held to be their most eminent characteristic, that property says nothing as to their relationship whether to spirit or body; for elasticity, considered in itself, is nothing else but the action or manifestation of a self-preservative power in the being or thing which displays the elasticity; and this disposition, so far as is known, belongs equally to the objects of the spiritual and those of the material world. If it be said that the phenomena and laws of light may be better referred to polarity than to a merely mechanical elasticity, so that not elasticity but polarity, or at least a peculiar aptitude for it, is to be affirmed of the etherial medium, the question remains where it was; for we are too ignorant of the nature of polarity to define or limit in any way the sphere of its possible manifestation, or even to speak of it in contrast with the action of an intimate elasticity. Upon the whole, it may perhaps be laid down as the general doctrine of our day, held equally on the strength of the actual observation of phenomena and of the traditions of all philosophy, that a universal æther or medium of light and darkness, of radiant heat and cold, and of chemical action exists, and that it cannot with propriety be called simply material (since its particles are not ponderable), although it is certainly allied to matter (since its particles possess inertia). While as to its relation to spirit, the taste and fashion of our times have not entertained the inquiry, though, without denying that the relation may be very intimate.

25. *It may possibly supply Substance for both Worlds.*—But if the æther exist at all, it is certain that it fills the celestial spaces, fills the universe, all the stars being bathed in it, invested by it, revolving in it. If there be an æther at all, it is the grandest of all created things, both in vastness and in fineness; and although in perfect keeping with the analogy of nature, we might conjecture that it was the general vapour of the concrete bodies, the suns and stars which it invests, yet with still greater legitimacy may we conjecture it to be the mother element, by condensation of which, in particular regions of space, existence has been awarded to concrete systems or special worlds.

Its every feature invites us to inquire whether its particles may not stand related to all that we know of chemical substances, as the least parts of which their molecules are composed; nay, more, whether the medium of light may not also be the mother element of the created spiritual as well as of the material system; for that spiritual natures or spirits are substances as well as material natures or bodies, will not and cannot be denied by any one who believes in their existence at all. And, therefore, there is nothing in the nature of things to foreclose the inquiry whether the Creator may not have made use of one mother element as the substance out of which primarily both spirits and bodies were to receive their being or substance. In reference to this matter, indeed, the popular mind in our day exhibits a very strange state of opinion. The materialist will hear of nothing but this, that mind is merely a phenomenon, merely a function of organization, and, therefore, that as to substance there is none in the universe but that which is material. He who believes in the soul, on the other hand, as that which is not to be explained by matter, and which is superior to matter, as if the better to secure its title to spirituality, often goes so far in his negations respecting it, that its existence becomes quite inconceivable as anything else than that which the materialist holds it to be. Our better part comes to be to him no more than " airy nothing," having the human body as a local habitation, and "soul" for its name; after which, some sixpenny alphabet of physiology is enough to make it questionable in his mind whether it be capable of separation from the body, or of surviving its dissolution. Thus both extremes meet; one in the daring belief, the other in the fearful apprehension, that all is over with man when this life is over; a tenet this which, more than any other that can be thought of, is destructive of all that is exalted in humanity and in the prospects of society. To avoid this evil, there is no way but to grant to the soul, along with *thought* which is its characteristic, those other conditions under which alone finite existence is conceivable by us, that is to say, *substance* and *place*. Now this has been done, and this is all that has been done, in supposing that the æther may supply substance for the being of spiritual as well as of material things. Place is indeed often denied of the soul, and the difficulty has been got over by a beautiful poetical evasion, viz., " the soul is its own place." But whatever may be the meaning of that, let any man consent to ask himself what he is thinking about, when he is in successive moments affirming the being of the soul, and denying a place to it, he will find that he is dealing only with words. Is it said that all place, all space is questionable; be it so. That questioning extends equally to body as to spirit. Let the externality of space be denied, still, spirit remains in possession of as good ground to stand upon as body does. Here is no danger. There is danger only in granting a place to body as a condition of its existence, and in denying it to spirit. This is a tenet, indeed, which either inconsiderately or surreptitiously, if not openly, confesses materialism, for this must be its landing place. It is true that thought refers itself to time, as in some sense its place; but a thinking Being cannot be conceived, and therefore cannot be believed in as a reality, if excluded from all space, or otherwise than in some place, though not necessarily confined to any.

Without prejudice, therefore, let us proceed to inquire into the æther, and the possibilities that may be in it, and, when necessary, apply our method to it. Let us regard it tentatively as the mother element, to which all finite beings and things are to be referred, as the substance of which they may possibly consist, or out of which they may possibly be constructed by omnipotence; for it is certainly a great rule not to multiply causes in vain; " and more is in vain (says Newton, when laying down the rule) when less will serve; for nature is pleased with simplicity, and affects not the pomp of superfluous causes." And, again, more specially in another place, this greatest of physicists puts the interesting query, " Are not gross bodies and light convertible into one another, and may not bodies receive much of their activity from the particles of light which enter into their composition ?" . . . . . " The changing of light into bodies, and of bodies into light, is very conformable to the course of nature, which seems delighted with transformations."—(*Opt.*, *Qu.* 30). Now, this is a hypothesis so beautifully simple in itself, and so respectably supported by authority, that it ought certainly to be fairly elaborated and applied to modern science before it be abandoned, and more complicated hypotheses resorted to.

26. *The Ætherial Elements are identical, indestructible, indivisible forces, inconceivably minute.*—Observation, then, which is always to be looked to in the first place, gives this for certain, that the æther consists of separate elements, or little particles, inconceivably minute indeed, yet each of them truly a substantial or real thing; and may we not safely add, *sui generis;* for the ætherial elements, as has been shown, are certainly not to be called matter or body, while there is no one to call them spirit. Now, to this grand datum of observation, the minutely divided character of the æther, and the singularity of the substance which its particles consist of, let us add the conceptions which our method supplies, and we shall obtain a definite hypothesis as to the constitution of the æther which, by an appeal to nature, will admit possibly of verification, and, therefore, of acceptance, as the ground of science, or of rejection from the region of the real.

Thus, from the attributes of the First Cause (11), it follows that the elements or particles of the æther are to be expected—1*mo*, All of them beings or things of power, powers, or forces; for they are the immediate creation or effect of a Power which is purely and absolutely power. The law of casual continuity, therefore, leads us to infer power as an eminent characteristic of the æther also, both in its elements and as a whole. 2*do*, Each ætherial element is to be expected to possess indivisibility, and all of them to be identical with one another; for when unity, however absolute, is to be repeated or imparted to multitude, it can only be done by imparting indivisibility to the unit and identity to all. 3*tio*, All the ætherial elements are to be expected to be self-preservative, permanent, or indestructible; for this is the normal expression of immutability in the producing cause—the immutable Creator.

27. *They may be called Elementary Forces, and represented by* ⊙.—

Adopting, then, from the history of philosophy, as the storehouse of the observations of thinking men in all ages, the æther or ætherial medium, light, or the medium of light, we propose to inquire whether there be not good evidence that it is the "offspring of heaven first born," and the mother element of all created things. And here let us repeat that, according to the evidence and our conception of the views which have been generally held respecting the æther, it is merely to be affirmed of its particles that they are real or substantial. It is not to be affirmed of them that they are material, any more than it is to be affirmed that they are spiritual. They cannot be called material, because they are imponderable; nor have they, according to the best conceptions that have been formed of them (Leibnitz, Boscovich), a limited magnitude or form, but are merely centres of force—a force which is indefinitely extended, though rapidly decreasing from their centres. Nor can they be called spiritual, if by spirit is to be understood that which is capable of thought and feeling, and possessed of liberty or auto-kinetic power, independently of all external relations. If a name be asked for them, it might be said that, but for the disfavour in which the term is held, they might very well be named monads, a term sanctioned by Pythagoras among the ancients, and by Leibnitz among the moderns. This term has, however, been prostituted in modern times by inconsiderate naturalists. We are, therefore, left without a fitting term for the ætherial elements; nor shall we now propose a new one; but, since it is only by their action as forces that they produce any phenomena, or become cognizable by us, we will generally, in the sequel, call them elementary forces, or, more shortly, "forces," adopting as their symbol the figure ⊙, which, being already in the hands of the printer, as the astronomical symbol for the sun, and showing itself to the eye to consist of a point with a circle round it, is very convenient for representing a centre of force (attractive), with its atmosphere or atomosphere, of force (repulsive) around it—"an atmosphere of caloric around it."

28. *The Elementary Forces are the Minima Naturæ.*—What the powers are in the individual ætherial element, considered as existing alone, we have no means of knowing, nor, indeed, of conceiving. In that case they must be rather potencies than powers, possibilities rather than actualities. But, by the application of a most simple mechanical conception to a medium, composed as we have now supposed the æther to be, we obtain two classes of beings or things, which must be not only different from each other, but the counterparts of each other.

The consideration of their divisibility, or further division, is excluded on many grounds; as—1*mo*, By the position assigned by them in the universe, that is, by hypothesis. 2*do*, By the adoption of the conception of Leibnitz and Boscovich, that, in so far as they are sectile, then further section is impossible, for their nuclei are inextended, and have merely position and power, not form and magnitude. 3*tio*, By the fact that there is no objective validity in the affirmation, that whatever exists in space must be divisible *ad infinitum.**

---

* This apparent doctrine is merely a psychological phenomenon, arising from the

29. *But they may come together and be united in either of two ways.*—But though not by further subdivision, yet are there two ways eminently distinct and different from each other, in which the elementary forces of nature may be affected. They can indeed only be unified; but this they may be in either of two modes essentially different from each other, giving products in the two cases, which must also be essentially different. They may be unified either by *confluence* or by *aggregation*, and according as the one or the other of these methods is realised, there must result one or other of two classes of beings or things, which shall even be the counterparts of each other in all their phenomena.

30. *Psychical Principles and Souls may possibly be produced in one way.*—By the confluence of many into one, new centres of force, which still retain true unity and remain unextended, constituting monads of higher orders, may be produced, and the powers of the individual augmented by degrees, until faculties manifest themselves, of whose phenomena scarcely any traces are discoverable in the elementary monads or elements of æther. And these monads of higher orders may, for anything that appears to the contrary, constitute the psychical powers of the lower animals, or principles capable of holding or believing, or living in relation with the objects around them, not merely by the laws of attraction and repulsion, but of desire and aversion. Nay, for anything that appears to the contrary, there may possibly be effected in adequate laboratories such as the cerebral mass in man, confluence of the elementary forces of the creation to such an extent that the Beings resulting shall be able, within their own spheres, to emancipate themselves from the purely dynamical relations under which the lower orders of them exist, and thus to attain to liberty, and the consciousness of it; and so to constitute Wills or Principles of volition; while at the same time their relational powers, or powers of holding surrounding objects by belief, reacting inwardly upon themselves, may give birth to *feeling*, that is, to peculiar states of self-belief which, under the impress of God, who is ever present and immutable, and of nature which is uniform, may rise to the dignity of Reason. And, in this way, the phenomena of intellectual life may possibly be secured to certain orders of Beings, along with a constitutional immortality of a spiritual part, when the organic undergoes

fact that in man, in the present form of his being, the principle of volition which directs the mind's eye, the analytic power, is quicker and more vivacious than belief, or the synthetic power; so that, after every stand that is made in belief, we can attack that position, and analyse or divide its contents, expanding them in imagination, so as to render them capable of gratifying the principle of volition—the analytic power—in this its extravagant habit of demanding the last word in every inquiry. The normal state of the intellect in such cases, the balance and well-being of these antagonistic powers, the analytic and the synthetic, the inquisitive and the affirmative, is when, after a certain descent in analysis, the principle of volition—the analytic power—ceases to act further, and bestows itself in contemplating that which intellect, which belief, which the synthetic power affirms; in a word, when synthesis and analysis, each after discharging its duty, meet again, in the simple act of holding that which was given at first, now no longer confused and obscure, as everything is when first seized by the synthetic power, but, by the deployment of the analytic power, the mind's personal activity upon it, now lighted up into a system of clear and distinct conceptions, and therefore fit for mental discourse and intellectual satisfaction and enjoyment.

dissolution. All this, I say, may possibly be, for anything that appears to the contrary.

31. *And Material Molecules and Masses in the other.*—In the same mother element, the ground may also have been laid for a material or molecular creation, such as that which our senses reveal to us; for, by the balanced juxta-position without confluence of the ætherial elements or forces, into symmetrically constructed permanent groups, they might so tie up each other, and lay each other under law, that though each, when existing free and by itself, were as wanton as a will-o'-wisp, there would ultimately result all the stolidity of matter. The further this process of aggregation was carried, moreover, the more each elementary force was surrounded by others, and consequently limited by them, the further would the resulting molecule or mass fall off in all its properties from the spiritual, the more fully would it manifest properties the opposite of the spiritual, that is the material. So far, therefore, the æther has nothing against it as the mother element.

32. *Hypotheses are sometimes of great value.*—Let us hasten to state, however, that all such views are essentially speculative and uncertain, and can never be affirmed in science except as hypotheses. Yet, let it not be denied, that in certain cases they may be affirmed as such, and with advantage. Such a hypothesis as that now broached, for instance, has, I think, claims to our scientific regard, greater than any of those other hypotheses which are current in our day, which refer all the phenomena of mind to molecular action, thus involving the awful consequence—fatal to all that is noble in human nature—that the individual ceases to exist when his organisation is dissolved. Although, therefore, such views as those now advanced, when regarded merely as they are in themselves, have no place in absolute science, yet in forensic science, in actual science (that is, reason at the bar of ignorance), their value may be often very great, as a set off against some other hypothesis. Their use is also perfectly fair and legitimate, except on the universal compact, that there shall be no hypotheses whatever in science—a compact this, of ideal beauty indeed, and one to which all might agree in words, but which no one ever yet kept in time past, or can possibly keep in time to come, except by renouncing all thought.

CHAPTER III.

OF CREATED BEING AND ITS LAWS.

33. *Being=Power.*—Our method has led us to infer (26), with respect to the elements of creation, that they must be elements of power, powers, or forces. But, independently altogether of our method and

our argument, the same may be affirmed with certainty not only of them, but of every being and thing which is cognisable by us; for the cognition of any being or thing implies evidence or self-manifesting power in that being or thing; and therefore it implies power in it. A being or thing, or substance, which is wholly destitute of power, must necessarily be wholly incognisable. In popular discourse, a great difference is indeed made between substance and power; but reflection shows that the difference is not so great as it is commonly supposed to be; nay, that "substance" is merely the statical, and "power" the dynamical conception of the same thing. Substance implies power; and to affirm substance and deny power of the same subject would be a paradox. While, therefore, by our method, calling upon us when we are investigating the creation, constantly to keep in mind the attributes of the Creator, and especially his infinite power, we are invited to infer the existence of power more or less in everything to which He has awarded existence, we are at the same time, by the constitution of reason, compelled to do so. As established, therefore, on a double-deep foundation, we affirm that the elementary substance, the ætherial element, cannot but possess power—cannot but be a thing of power.

34. *Laws for Created Being are suggested by our Method.*—But a fact so general, although quite certain, is of little avail for the progress of science, unless we can also ascertain the forms or modes, or laws of action of the power or powers which the ætherial elements possess. Now, though these have been somewhat elaborated by mathematicians ever since the days of Huygens, and are much laboured by that class of inquirers in our own day, yet we dare scarcely hope to discover the fact as it exists in nature in this way. It is easy to see, that the labours referred to have not the discovery of the fact as it exists in nature for their aim, but some conception of that fact which may suit the present state of the calculus, and admit of construction and discussion by the use of the mathematical symbols at present in vogue. Now, these symbols, the calculus, in its present state, is such, that the most conflicting hypotheses will sometimes serve this purpose equally well, and yet give results so similar or so ambiguous, that verification is extremely difficult where it is not altogether impossible. Thus, the law of force in the ætherial elements has had able advocacy between the limits of the inverse first, and the inverse fourth power of the distance; and all sorts of conceptions have been proposed as to the mechanism of the æther. Everything, in short, is tolerated, nay, respected, if only it admits of the form of an analytical expression. Leaving to those who have devoted themselves to this mode of research the entire field in that point of view, let us here proceed according to our own method and apply it. Now, by it we are immediately led to infer, that every ætherial element, every created being and thing, shall have two distinctly marked powers, and be the subject of three dominant all-pervading laws. For, besides power in the creative cause, which is, as has been shown, embodied in all created things in the very intimacy

of their nature, there are, as essential attributes of the Creator, Immutability and Unity; and each of these, if imparted or impressed upon the objects of Creation, must give rise to a distinct class of phenomena, and furnish a grand law for all created beings. But, wherever there are two laws destined to co-operate simultaneously in the same field, a third must result from their synthesis. And thus, we look for three laws of Being. They are as follow :—

35. Law I. *The Permanency of Species.*—The immutability of the First Cause leads to expect universally in every individual of every kind, and especially in every type of individuality (*i.e.* in every species), whenever existence has been awarded to it, a certain identity or unchangeableness; and, therefore, viewed in reference to time and action, a certain power of continuing true to itself in successive moments or epochs of its existence; nay a certain power of falling back upon, of restoring and of reproducing its original, when in virtue of any accident, it has been for a time disturbed or lost. Now of such a law, the phenomena of personal identity and memory are illustrations in the spiritual, as is the embryo and its development in the material sphere. Nor is it confined in its operation to the higher walks of nature. It holds equally in the molecular world. Among chemical agents the law of the permanency of the species prevails as well as among plants and animals. And hence, in fact, the main reason why the chemist is unable to decompose or transmute the molecular species to which nature has awarded existence, and which she has long cherished in her depths. And hence the cause why there are so many phenomena in the laboratory, which cannot be made to fall in under any specific laws of affinity. Nay, this law of permanency holds good in reference to mere motion, and determines its law. Thus, as the first element of any motion (being but the progress from one point to the next adjacent to it), cannot but be a straight line, so does the law of the permanency or continuity of the type (of motion in this case) determine that this straightness shall be preserved so long as the motion is continued under the same conditions of existence, which is the first law of motion.

36. Law II. *Universal Sociality and Attraction.*—But the First Cause, as author of all, is not only immutable, He is also one. And from this attribute we are led to expect that there shall exist in all the multiplicity of beings and things in the universe a disposition or tendency to return into an unity; we are led to expect that a mutual sociality or attraction will universally prevail. Nor need we dwell upon this. Observation and good sense universally affirm it. The fitness of universal love for the moral sphere, and the fact of universal attraction in the material, are the characteristic tenets of modern belief. And as the grand law of inertia attaches to our first law of Being, so might it be shown that the law of gravitation arises out of this our second. Thus, since unity and identity rule in the sphere of the law, we are led to infer that the amount of attraction shall be identical at all distances from the centre of force, that every successive spherical shell in the concentric series extending outwards into

space, shall possess and be constituted by the same amount of force. But if so, then, when estimated along any line or radius, that force must obviously lessen as the surface of the spherical shell increases—that is, inversely as the square of the distance, which is the well known law of gravitation.

37. LAW III. *Universal Assimilation and Harmony.*—We thus find in creation two grand cosmical laws echoing and representing amid his works, the essential attributes of the Creator, the one, (the law of the permanency of species) His immutability; the other, (the law of universal sociality and attraction) His unity. But wherever there are two laws of a dynamic nature there must always be a third resulting from their operation in synthesis, and expressive of it. For a third grand law of Being, therefore, we have to look in the present case. And in order to find what this third law is, we have only to consider that the law of attraction or sociality, more generally of unification, implies that things act upon each other through their whole sphere, and at all distances, ever tending to bring all into one. The other law, again (the self-preservative power of every being and thing), provides with no less certainty that every object which, with regard to its own internal make, possesses a statical structure, shall act according to its nature, that is, specifically through the whole sphere of its influence; for the boundary of a species in space, when that species is considered as a member in the system of the universe, can be none other than its boundary as an agent, or the boundary of its influence. Since, then, our first grand law, the law of the permanency of species, provides that every species acts specifically for the preservation of its own characters, we must hold that it does so through the whole sphere of its influence; for if it did not, it would not be the same species everywhere that it acts, which is contrary to the conception of a species. But if it so act, it follows from this mode of action (the species-preserving operation), borne as it were on the wings of the law of universal attraction, which reaches into the extremest distances, that there must result, as the whole operation of one thing upon another, not only a tendency in the one to unite with the other, but to assimilate that other to itself—an operation which must go on, at least as a tendency, though confluence or unification be forbidden. And hence a grand result; hence, between all beings and things in creation, a specific action and reaction, a reciprocal operation and influence, a general giving and taking, having universally mutual assimilation for its end and aim, on the attainment of which alone it will cease—a crisis this, however, which, in virtue of the first law of being (the permanency of species), is indefinitely postponed.

38. *These Laws are co-extensive with Creation, and determine the Phenomena equally of the Intellectual, the Moral, and the Material Sphere.*—From the dominion of these laws, those phenomena must, of course, be excepted, which are the products, not of law, but of free-will. But, with this exception, no other primary laws are assumed in our philosophy. All others are only subordinate expressions of these three, and products of their operation in synthesis.

When we look higher than creation, we see them retreating into the bosom of the Creator, and leaving us in possession of His absolute attributes only (to which, however, the moral attribute of love, immediately attaches even in eternity, as soon as we conceive Him as One existing, not in solitude, but in sociality, *i.e.* as the triune God). But when we look abroad upon nature into whatever realm, these three laws we apply universally; they are to us the full expression and the appointment of the Divine will, to bring creation to be what it is under his all-seeing eye, and continually exerted power.

And here it would doubtless be much in their favour could it be at once shown that the characteristic phenomena of intelligence and sensibility, as well as of the material system, are due to them. But spiritual phenomena are cognisable by us only in synthesis with those of a material organisation. It is through bodily organs alone that spirits normally manifest themselves intellectually to each other at the surface of our planet; and as to the moral system, it is an economy having for its aim the wellbeing, not of the spirit within only, but of the whole man, his bodily as well as his spiritual part. Almost all mental phenomena, therefore, are the products of relations, with which, in these circumstances, it is obvious that the somatic element perpetually mixes itself up; and, therefore, it is plainly desirable, before we touch the doctrine of the soul (which thus conceal itself from us in the body), that we should learn as much as possible of the structure and powers of the latter. This done, a pure pneumatology might be attempted, that is, a science of mind considered as existing in its own rights, as the Being that it is in itself, and as in a definite relation with God on the one hand, and with the world on the other. And it is on the strength of the results of long sustained inquiries of this kind, that I am so bold with regard to these three laws, and cannot give up the hope that the time will yet come when science will be able to get out of the labyrinth it is in, and philosophy to teach men to begin at the beginning.*

---

* For the harmony of the intellectual, and especially the moral economy with these laws (not articulately stated), the friendly reader may, in the meantime, consult *An Inquiry into Human Nature. By the Author.* P. 120, and *Passim.*

PART II.

CHAPTER I.

THE FIRST LINES OF MORPHOLOGY.

39. *The Laws of Form and Structure.*—Leaving for hereafter the nobler phenomena of intelligence and sensibility, let us now as soon as possible reach the material sphere. The opening into it plainly is by the doctrine of form, which also implies structure; for what is structure but inner form? And here the laws of Being which have been laid down prepare us for six grand classes of phenomena, on which the resultant forms and states of molecules and masses must mainly depend, viz., Regeneration, Union, Solution, Polarity, Symmetry, and Sphericity.

40. *Regeneration.*—By this is meant the tendency of every individual, whether atom, molecule, or organised body, after it has been anyhow changed or defaced, to revert to, redevelope, or regenerate its former self as soon and as far as the conditions and other laws of its existence will allow. This, the first law of Being, when viewed in reference to space, and the third when viewed in reference to time (under which change of view both these laws become one, viz., that of assimilation), lead us to expect. As examples may be mentioned, the regeneration of ammonia out of NH^3 by chemistry, where these same elements (as in organic substances) had constituted ammonia at its birth; and the constant recurrence of HO in the formulæ of chemical species reduced from sugar, with a view to the preservation or regeneration of CHO, that being the original saccharine element which organic nature first succeeds in constructing.

41. *Union.*—The second law of Being, which affirms an universal tendency to union, often effects actual union. And from this it is obvious, that a vast multiplicity of morphological phenomena must result. Since, however, union cannot take place without a compromise of individuality and specific character, the phenomena of union are moderated by the first law of Being, which ever aims at the conservation of individual and specific characters.

42. *Solution.*—The second law of Being tends directly to reduce all bodies to the dense, the solid state. But this, not only does the first law, which makes universally for the æriform state, oppose, but also the fact that dense bodies in small quantity often exist immersed in fluids of large quantity. Hence, under the third law of Being (assimi-

lation), the fluids may be often expected to succeed in assimilating the solids to themselves, that is, in dissolving them; and various fluids, as, for instance, water, alcohol, and ether, must have various powers in this respect when poured over the same solid, according as they adapt themselves more or less to that substance, and it to them. Moreover, since all substances are immersed in the universal ether, their tendency to dissolve in it, that is, volatility, may be expected to be a very general phenomenon.

43. *Polarity.*—Where union is anyhow prevented, the tendency to it operating under the third law of Being, must produce those phenomena which are usually ascribed to polarity. It must manifest an orderly series of phenomena which coincide with those of polarity, and explain that remarkable phenomenon. Thus, if a piece of zinc be plunged in a *solution of sulphate* of water, the latter must forthwith exert an influence to assimilate the zinc to itself. It does in fact succeed, both making a *solution* of it, and each element of that solution a particle *of sulphate* too. But after this, if any of the *solid* zinc remain undissolved, it must in its turn tend to assimilate the solution to itself. Accordingly, it gives something solid, viz., crystals of sulphate, also; to effect which, however, a crystal thrown in, being already more similar to the existing solution of sulphate, will exert a greater influence. Let a piece of copper be now immersed, and placed in such relation with the zinc, that the assimilative influence destined to take place between them may be kept up (current), the zinc must now tend to assimilate the copper to itself. It does, in fact, succeed in coating it with zinc recovered from the solution. And this effect the copper, though without the zinc, is more or less competent to produce, in virtue simply of its metallic nature; for particles of metallic zinc are much more similar to copper than particles of sulphate of zinc are. And hence, generally, so long as a difference continues to exist between any Z and C, or any H and O, there must ever tend to proceed from the Z towards the C, or from the H towards the O, a force representative of the Z or H, upon the C or O; while at the same time under the same law, there must ever tend to proceed from C to Z and from O to H an equivalent current upon Z and H, representative of C and O, each element aiming at the assimilation of the other to itself. And hence, therefore, the absolute condition of the establishment of a current is a difference between the elements employed, and the condition of the continuance of the current in energy, is the maintenance of this difference in a high degree. But to accomplish the assimilation of dissimilars, the shortest course where it is practicable, is unification by mutual embrace, and the merging of difference in the construction of a new species. (41.)

44. *Symmetry.*—But here it may be asked whether, from such a law, there will result anything better than merely chaotic masses, all molecules, it may seem, being eager to run together merely to get over their differences, and to hide themselves in the mass. On due consideration, however, it will fully appear that the molecules and masses formed under this law will not be chaotic; nay, that the law of

assimilation will tend directly, both hour by hour, and age by age, to symmetrize every molecule and mass which exists in nature. For what is symmetry? It is nothing else but similarity. And the law of assimilation, whether in forming or transforming a molecule or mass, must be ever operating in the interest of the symmetry of that molecule or mass, ever disposing of its parts or particles, in similar positions in relation to the centre, the axis, or the equator of the group, as the form may demand. Thus, in our great law of assimilation, there is implied that which is so great in nature—the law of symmetry.

45. *Sphericity.*—But here another question presents itself, viz., What is the form of greatest symmetry? for to that form it fully appears that molecules and masses, under the grand law of assimilation, must ever tend as their form of culmination. Now, to this question the answer is explicit. For that form which possesses a maximum symmetry, is plainly that which has the greatest number of similar points or parts similarly related to the same point or part; and this condition the sphere (spherical shell) most fully satisfies. And thus we arrive at the spherical as the *terminus ad quem* of all molecular constructions, nay, of all ultimate permanent objects. Seldom, however, is the terminus exactly reached in any case. The object aimed at is either fallen short of, or shot beyond. And thus is nature kept for ever weaving and unweaving, until the Creator shall command time to be no more—yet not with any lasting danger to the creation during the period of its existence. In our philosophy, of which the first terms are—the Creator and the creation—absolute and aboriginal power on the one hand, and originated and finite power on the other,—if an opening is made for the possibility of evil (and some creature or other may even be expected, at some epoch or other, to rise up against the Supreme Power), yet that possible evil must necessarily be finite, for it must necessarily arise on the side of the creature; and it must also be remediable, for the power of the Creator is infinite. Meantime, by the institution of the laws that are here conceived, that is, the prevention by intelligence of unmeaning differences by the construction of permanent species and types of being, is there not, along with an universal sociality, attraction, or mutual influence, a process set a-going which must issue in universal harmony? Is not unity appointed to make its apparition in the midst of variety, species to group themselves into genera, and all phenomena, to classify themselves under the laws of intelligence? And is not all this secured by the very being and attributes of the Creator, whose power and providence meanwhile are ever over all?*

---

* To have given a truly scientific character to this work, it should have been shown, both in general, and in every particular case, that symmetry and sphericity are the products of polarised action, as well as of the law of assimilation. But for this immense space is required.

CHAPTER II.

THE PROPERTIES OF MATTER.

46. *The Attractive Centre of the Ætherial atom is invested with an Insulative Atmosphere.*—Attraction being one of the grand laws affecting every atom in the universe, it follows, of necessity, that if there is to be a creation expanded in space, as we know that the actual creation is, there must be a provision for keeping the particles of matter apart from each other more or less, a provision for giving and maintaining volume; for a plenum of absolute solidity need not be considered. Such a provision, therefore, something to insulate the particles of matter, and keep them suitably apart, and from falling into each other, we are to look for all through nature, and especially in the æther itself, (nobis) the fountain of material molecules and masses, and the mother element. And here it is necessary to enter into some details as to the constitution, or at least the action of this insulator.

47. *The real Nature of this Atmosphere is Inscrutible.*—It is indeed true, that to effect the insulation of molecules, to give them volume, and to maintain them true each to its own, for any length of time, nothing more would be required than the Divine will that it should be so. And in this fact, doubtless, absolute science finds its limit and its last word. It is no less true, however, that such a doctrine being purely metaphysical, is wholly inadequate for the exigencies of physical science. And, therefore, though not in the hope of reaching the very reality itself, yet in the hope of finding some conception of that reality which will satisfy the demands of science, it is lawful to proceed a little further. When the theological truth has been ascertained and admitted, and the fact laid down metaphysically, and in accordance with abstract reality, it is lawful in physical science to construe it physically. It is lawful to express the secret in constructions in space, and time, form, and motion; for this is indispensable to distinctness of thought, which is the primary condition of science in general, and of demonstration in particular. But since such is the dangerous ground we enter upon, let us proceed with caution, so as to avoid, if possible, offending truth, whilst we venture to represent her in language answerable to our conceptions, though possibly not her own.

48. *But it is Calorific, whatever it may be besides.*—In the first place, then, we must grant to this the investing atmosphere of atoms and molecules, by which they are insulated and kept from falling into each other, a substantial nature; for it has action and power, and to all appearance is variable in quantity around the same amount of attractive force, and transferable from one molecule or mass to another. Apart from it, indeed, the last elements of nature are (nobis) merely centres of attraction. If, therefore, we are to regard matter as substan-

tial at all, it is in this the investing atmospheres of atoms and molecules that the bulk of its substance must lie. It is still a question, indeed, whether the phenomena of heat are due to a substance or to motion. But that question will be put to rest, and happily compromised, if we regard these phenomena as due to motion in a substance, and that, the very same as we are now inquiring into; and which, therefore, to avoid circumlocutions, we may for the future refer to as caloric. Every atom and molecule, according to our view, is thus a centre of attraction, or a constellation, group, or nucleus of such centres invested by an atmosphere or atomosphere of caloric.

49. *Its Elementary Form is Spherical.*—And here the deeply interesting inquiry presents itself as to what is the form of repose, or the normal form of this atmosphere. And in answer, might we not postulate the sphere as that which is adopted by general consent, and which our views legitimise in a remarkable degree, the sphere being, as has been shown (45), the form of culmination, which our third grand law of Being ever tends to develop? This we might safely do. But either in postulating the sphere, as that which has been generally inferred inductively, or in adopting it as given by law, there is a great defect in a philosophical point of view. Such a view withdraws the creation too much from the Creator; for if it do not exclude, it does not invoke either His presence or His power as conditions necessary to the maintenance and wellbeing of nature. It also implies the animation of the universe with an independent life of its own. In a word, it makes a break and a duality in philosophy, where otherwise there would be a continuity and an unity, and yet without pantheism. The view which regards any special form as a property of elements or atoms, either by original creation or in virtue of any law they are under, is defective. To complete the train of thought, and to maintain the consistency of philosophy, as she proceeds from the fountain head to regale herself far down the streams of being, it is needful to be shown that determinate form first makes its apparition, and is maintained in creation, by the presence and power of the Creator. Form may then become the medium through which infinite power and finite power (the two, as may be shown, essentially antithetic) may be co-ordinated and reconciled. Confining our regards then to the æther, the mother element, does its relation to the Creator as the first-born of creatures, determine or indicate anything as to the form of the particles of which it consists? At first sight, the very suggestion of such an inquiry may seem strange, and the attempt to solve it absurd. And yet something does appear. Thus, the ætherial particles are things created, owing both their original existence and their continuance in being to a Power always existing in difference with them, and, as it were, external to them; a Power ever bounding and limiting them. If, then, we reduce, as it has been shown that we are obliged by the exigencies of physical science to do, this fact (in itself wholly transcendental) to a dynamical conception, there is given, as bearing always upon the intimately plastic or amorphous atmospheres of the ætherial atoms, a breath, an impress

all around and everywhere the same. But if so, then these atoms will ever tend to confine themselves to that form which has a minimum of superficies in relation to its solid contents. Now, that form is the sphere. To the same form, therefore, as we have otherwise arrived at, this method leads us ; but with this difference, that according to this view the ætherial elements do not possess a spherical form in their own right, nor have they it by an original fiat; in a word, they are in no sense animated by it. They have it merely as the will of the Creator (expressed to them in his ever powerful presence), that though He is pleased to award existence to that which is not Himself, and which is by consequence infinitely inferior, and more or less dangerous, yet it shall occupy in each of its elements a minimum of space.

But however it be conceived, it is settled in our system, that the form of the ætherial elements, when in a state of repose, is spherical. And from this fact also, under the third law of being, we arrive again at the sphere generally as the form of culmination for all molecules and individualized masses; for such is the ascendant of the æther, in which all the bodies in the universe are bathed, and out of which (nobis) they all are formed, that the influence of its elements to assimilate all other forms to their own must be paramount.

50. *The Forms of Objects are their Isodynamic Boundaries in Space.*— It may be here remarked, however, that the form of a molecule or of a material object, as here conceived, is not the palpable boundary of that object in space, as decided by the eye-sight or the finger tip, nor, indeed, is it any conceived limit in space, such that on the inside of it there is the thing, and on the outside of it there is nothing. To venture so far in defining physical form, is to involve ourselves in a thousand perplexities. It is to do a homage to sense and imagination, which reason will not sanction, and to fill all nature with wonders. Bodies are recognised in science only by their phenomena, and therefore only by their agencies. And it is obvious that one agency, as for instance, that repulsion of light which gives a visible surface to a body, takes place at one distance from the centre of that body. Another agency, as for instance, that repulsion, which is so strong when other bodies are applied, as to constitute impenetrability, takes place at another and a greater distance (as is expressed by the common saying, that it is impossible to bring two bodies into actual contact). Another, as for instance, heating power, extends to a still greater distance ; while, with regard to attractive action, visibility, or self-manifesting power, no limits are known. Observation, therefore, unites with reason in calling upon us to refrain from applying the common conception of the form of a thing (viz., that which lies between something and nothing and divides these two !) to real beings and things except in a popular way. The form of an object, when conceived scientifically, is rather that enclosure in space around its centre which gives or manifests the isodynamic boundary of some property of that thing, as for instance, its property in relation to light, or impenetrability, electricity, magnetism, etc. It is, therefore, physically correct to speak of the visible form, the tangible form, the electro-magnetic

form of an object; but to speak of its form, without limitation, is to use abstract language which cannot lead to positive science; unless by form generally we mean visible form, as is indeed usually the case.

51. *The Minima of Bodies are Perfectly Elastic and Impenetrable.*—We thus arrive at a somewhat definite view of the ætherial element, and of the laws of the development of molecules and material species out of these ætherial elements; and we are helped so far on our way towards the scientific examination of bodies composed of molecules. According to what has appeared in the preceding pages, the ætherial element, or elementary force, is a centre of power potentially attractive, ever tending to effect the unification or aggregation of others along with itself, but that, within the limits or in the presence of a co-ordinate repulsion which ever tends to maintain the individuality of each, by a resistance on the part of each to the intrusion of all or any of the others, into the place it occupies, meanwhile, maintaining to the utmost possible its own sphericity. But such a power or mode of action, is simply an articulate view of what is familiarly known by the name of elasticity. At elasticity, therefore, perfect elasticity, in reference to the elements of all bodies, we arrive, as one of the most eminent phenomena of matter. And that every inspection, even of concrete masses as well as of fluids, leads to such an inference, and verifies it, will at once be admitted. The conception of bodies, as perfectly hard and perfectly soft, is merely technical, and, for the uses of abstract, not truly physical, science. The sound of every breaker falling on the bosom of the water beneath, from the beginning of time to this day, and the jet of spray which fills the air in answer, proclaims better than Œrsted's apparatus, that water, with all its softness, is as elastic as glass. And certainly the whole progress of science tends towards the conclusion that but for molecular displacements and entanglements in certain masses and peculiarities of structure, seldom satisfactory to nature herself, all concrete bodies would prove themselves to be perfectly elastic, not less than fluids. We infer, therefore, with confidence, that the ætherial element, all atoms, and molecules and molecular masses generally, whose constituent atoms are in fixed position, are perfectly elastic or resilient, and all others more or less elastic.

And if they be perfectly elastic, it follows that they are perfectly impenetrable also; and in every case impenetrable to the extent that they are elastic; as for instance, universally, in reference to their ultimate elements or atoms. There is, in fact, no room for making a distinction between elasticity and impenetrability, unless we allow such a conception as that of hardness, (resistance other than according to the laws of elasticity,) nothing of the kind, however, being known in nature. In every other case impenetrability is simply a case of such elasticity as is adequate to maintain its ground, in the face of the force which aims at occupying its place.

52. *But dissimilar Molecules are mutually penetrable or dielastic towards each other.*—But our laws of Being lead us, at the same time, to apprehend that this great cosmical phenomenon of elasticity shall

not universally take place according to that very simple mode which is commonly ascribed to elasticity. Thus we have seen that all the laws of Being sum themselves up in the law of harmony, and that of this law the successful fulfilment demands a free scope for the law of influence or assimilation. Now, of this law, in its turn, the successful operation demands the sustained presentation of one object to another, and the nearer the better. If, then, there existed between all individualized atoms, molecules, etc., those dissimilar to each other, as well as those which have been effectually assimilated to each other already, or which were from the first identical, a mutual elasticity or repulsion, the operation of this grand law of harmony would be interfered with and prevented. Instead of remaining near each other, and acting on each other assimilatively in the interest of harmony between them, two dissimilar atoms, in that case, would have to thrust each other away, and so to retire from each other's presence, and so to cease to act upon each other assimilatively. Our third law leads us, therefore, to expect between dissimilars some modification of the law of elasticity as usually conceived. It leads us to expect, that mutual elasticity (considered as mutual repulsion) shall be found to exist only between such atoms or molecules as have been submitted to the third law of being, the law of assimilation, and have been assimilated to each other, or have been from the first identical; while, with regard to such as still continue to be dissimilar, it leads us to expect that there shall exist no elasticity or repulsion between them, except at those small distances at which all atoms and molecules whatever may be regarded as similar (which they may at very small distances, inasmuch as all are composed of similar monads), the law of elastic or repulsive action in that case being good only to prevent the confluence of several individuals into one, but not to keep them disunited and at a distance from each other. It is by some such hypothesis alone that this more particular law, the law of elasticity, can be brought into keeping and subserviency to that more general law, the law of harmony. It is, therefore, legitimate for us to look to nature with a view to verification. But for such verification do we need to go far? The Daltonian formula, that "dissimilar æriforms are as vacua to each other," what is it but a most expressive statement of the realisation in nature of our inference? And that the same relation of mutual vacuity among dissimilar molecules obtains both in liquids and solids, when freedom of motion is allowed to their constituent particles, do not all the phenomena of solution and of chemical union prove? The principle of elasticity, then, has two co-ordinate manifestations, according as it operates between similar or dissimilar molecules; impenetrability and recoil being the phenomenon in the one case; mutual penetration and no-recoil that in the other; and these two classes of phenomena we may distinguish by the terms elasticity and dielasticity. (We shall afterwards find, I trust, that they are but a dynamical conception of the exquisite phenomena of polarity.)

53. *This may be explained mechanically by the theory of "Inter-*

ferences."—And here again, for the sake of distinctness, though possibly at the expense of truth, let us reduce these phenomena to a mechanical conception. And, for this purpose, let us part with the common notion that the elasticity of atoms is a property inherent in the very substance of their atmospheres, a conception this, which, when looked into, vanishes, and leaves us just where we were without it. Since elasticity, considered as a phenomenon (in which point of view alone we have to do with it), is a mode of action, let us conceive an apparatus or mechanism in the atmospheres of molecules, from which it would result as the mechanical effect corresponding. Nor is this difficult. We are, in fact, informed by the phenomena of light, and of sound, and of all elastic media which fall under the cognizance of the senses, that these media are continually actuated by undulæ. Let us, then, as our first step, suppose that the elastic atmospheres of molecules also, are continually actuated by undulæ, emanating from the nuclei of the molecules. And, as our second step, let us co-ordinate this supposition with the third grand law of being, the law of assimilation. This done; we obtain, in the atmosphere of every molecule, a perpetual system of radiant undulæ, assimilated in form and structure to the nuclear form and structure of that molecule, and representing it.

54. *Hence the phenomena of Diffusion and Osmose.*—But in such a mechanism or apparatus, though we have been led to it simply by the analogy of nature, and the laws of being, we see how the observed phenomena both of elasticity or mutual repulsion between similar molecules and of no-elasticity (except as the least distances), or dielasticity between dissimilar molecules, must result; for in the former case, the case of similars, the undulæ of all the molecules exposed to mutual action being similar and of the same dimensions, they must, when emanating from their respective nuclei, meet face to face, one after another, and thus, ever thrusting against each other, the nuclei whence they emanate, if free to move, will recede from each other, and the ordinary phenomena of elasticity result. When again the nuclei of any adjacent molecules are dissimilar to each other, the undulæ in their atmospheres will be dissimilar also, and will meet and interfere with each other but little, if at all; and consequently between the molecules which are dissimilar in any mixture, there will be little or no repulsion compared with that which there will be between those which are similar. As homogeneous, therefore, both will prevail in the occupation of space, each set of molecules will soon attain the maximum distances from each other, which the limits of the space, in which they are confined, allow; in other words, both sorts will soon be completely diffused, each doing but little to obstruct the diffusion of the other.*

---

* The diffusiveness, however, or time of diffusion, must vary in different cases under specific differences, as also generally with the inertia of the molecule. Thus the exquisite elasticity of æriform or fluid media, leads us to infer, that during diffusion, everywhere, at least, at the surface of this agitated world, the constituent particles of æriforms must be continually in a state of oscillatory motion, each being thrown back-

What we have now got, therefore, as a conception of the atom or molecule of a chemical or natural body, is *a nucleus*, consisting of an aggregate of ætherial atoms or monads few or many, differently combined in different cases, and thus constituting different chemical species, of different atomic weights and properties; and around each an atmosphere or *atomosphere* of a substance essentially insulative, conservative, or elastic; and, at all times, actuated by systems of undulæ (or wavelets) representative of the nucleus itself, and therefore carrying out its specific characters and action as far as its influence extends.

55. *The attraction of the Elementary Forces, when constituting the Nuclei of Molecules, determines these Nuclei towards Union.*—So long as the forces exist in the æther, and constitute that most completely expanded medium, no affirmation is made as to the manifestation of attractive power by them. The most satisfactory supposition, as an initial hypothesis, respecting the ætherial atom when forming the æther is, that then its attractive and repulsive powers are in a state of equilibrio and tension, "the æther consequently being in some sense a hard body" (Fresnel), incapable in itself of any phenomenon whatever, though containing potencies which, when drawn out, can constitute it the parent of a whole universe of phenomena. But let several ætherial atoms have been somehow forced together, so as to constitute the nucleus of a chemical atom or molecule, and then in consequence of the breaking of the shell, and the loss of caloric, which must have been sustained, it is assumed that each of the elementary forces constituting the nucleus, manifests a constant attraction for every other. And hence, atoms and molecules which are dielastic towards each other, that is, dissimilar, will tend when they come near each other, to unite into a larger molecule, and to cohere as such.

56. *The law of Assimilation issuing in that of Sphericity, determines the modes of that Union.*—Although our primary laws are no more than three in number, yet it is pretended that they are adequate to explain all the phenomena of the laboratory. This will appear, we trust, in some measure, as we proceed. Here it may only be remarked, as obviously attaching to these laws, that however varied in detail the phenomena and products of atomic union, they must all culminate towards the construction of molecules, which shall be at once spherical and cellular. Their sphericity is called for by our third law; and it may already be perceived, on ordinary dynamic principles, that if there be in the interior of a molecule a group of essentially repulsive forces such as the elementary forces that constitute molecules are supposed

---

wards and forwards through small spaces, in the direction in which diffusion is taking place, as well as in other directions; and hence an impediment and retardation to diffusion; of which, moreover, when the force causing the orbits or excursions in the molecules, and the weight of these molecules are known, the law is also well known. Thus, when the force is constant, as it is in æriform media generally, the molecules must be impelled with velocities in the inverse duplicate ratios of their weights; and diffusion of different gases will therefore take place through any aperture in the same ratio, just as if the different molecules were cannon balls of different weights thrown from the same gun, with the same charge of power; all which has been lately verified by experiment in the laboratory of the chemist, as it was long ago in that of the artillery-man.

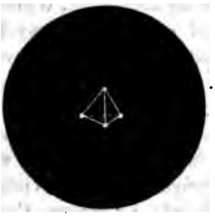
to be, they must tend to repel each other, and to recede from the centre, so as ultimately to render the molecule cellular.

57. *The same law also determines the volume of Molecules.*—It is a simple operation of the law of assimilation to insist upon the distribution of caloric among molecules, until they retain around their nuclei an equal quantity, and therefore, an equal volume, when all are at the same temperature. Considering the great differences which there must be in the genesis and masses of different molecules, we are not indeed to expect that this result shall be rigorously effected, or that the volume of all molecules even of the same order, shall be that of 1 : 1 ; but we may expect in general that when not, it shall be that of 1 : $\frac{1}{2}$ or 1 : 2 or 1 : 4, which are the simplest ratios after that of 1 : 1. But what shall we assume as the unit volume to which the others are to be referred? To this, the proper answer is, the ætherial element itself as existing in the æther; nor is it impossible that that may one day be discovered even in parts of an inch. Meantime, as it is unknown, and the use of it merely as a number would give atomic weights and volumes always the same, we must seek for some other standard. And after it, certainly on the surface of the terraqueous globe, water is the dominant species. A particle of water, therefore, will be our unit-volume for dense molecules. We conclude, that atoms and molecules, in forming into groups which are to assume the dense state whether liquid or solid, will tend to build together in such numbers, that the resulting group shall just naturally tend to occupy the same volume as a particle of water. With regard to true æriforms, as the systems of undulæ emanating from their nuclei, cannot but tend to separate such of them as are homogeneous to the utmost, their actual volumes in any case must be determined by the pressure that is upon them. Under equal pressure, however, they must manifest the law of assimilation in volume; (57) and here the natural unit-volume is obviously an element of common air.

58. *But Volumes must ever tend to increase, so that Molecules shall ultimately construct masses, which may attain to sensible magnitude.*—A tendency towards further synthesis more and more, must result under the third law of Being, from the assimilative presence of the great globe itself, which is so vast compared with any and all of the objects which it bears. Out of any symmetrical molecules, therefore, we may have crystals, and out of cellular spherical molecules (the production of which completes the first epoch of nature's synthesis), we may have plants and animals, still tending to increase, although constantly thrown back upon themselves by forces limiting their growth, each after its kind, and all of them under the first law of Being true to the type which was originally designed and constructed by the Creator.

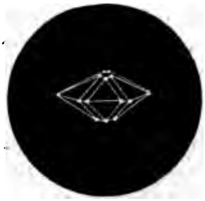
CHAPTER III.

THE GENERAL FORMS OF MOLECULES.



A

59. *Heteropolar Molecules.*—There are some forms, as for instance the tetrahedron or pyramid, the opposite extremities of the axes in which are dissimilar to each other. As an example, may be adduced that species which meets us the first in our synthesis of ætherial elements, viz., a group of four, which is the simplest combination that is isometrical, or in symmetrical relation with space in all its dimensions. This, fig. A may represent, the black circle being its atmosphere, the form in the centre, its nucleus. It is an elementary tetrahedron, the four ætherial forces which constitute it being the angles, and the lines of force extending between them, the edges. Its atmosphere, when left to itself, must, however, be spherical. And thus between the form of its nucleus and that of its atmosphere, all possible forms of isometrical molecules must lie; for such is the relation of the tetrahedron to the sphere. They are the extremes of the isometrical series of forms. But what we have here to remark, is its heteropolarity, each angle or apex = ⊙, having a facet or base = 3 ⊙ opposite to it as extremities of the same axis, a condition of form to which it will soon appear that peculiar and important properties attach, and which can be by no means uncommon, since not only simple bodies such as this, which we may designate A, but all binary combinations, such as HO or CH, and many ternary, such as CHO, CHN, and even quaternary, such as CHNO, must belong to it.

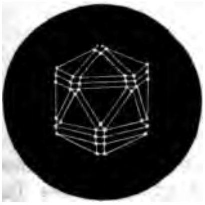


B

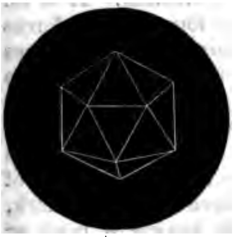
60. *Homopolar Molecules.*—But let A borrow from the æther, or from some molecule which is giving off ætherial matter, another ætherial force; and let this additional ⊙ be disposed of in a position opposite to the centre of one of the facets of A, at the same distance from that facet, as the ⊙ on the other side, we now obtain an individual of another order of forms (see fig. H page 45), an order in which the opposite extremities of one axis are similar, and which, therefore, we may designate homopolar forms. A couple of A united, base to base, give another form of the same order, (see fig. H, page 36). While 5A, united each by an edge around a common axis, (see fig. B), give another, agreeing with H (page 45), in being

homopolar, but differing in as much as it is a pentagonal, not a trigonal bipyramid.

61. *Isometrical Molecules.*—The law of sphericity, however, is not fully satisfied merely with the construction of such molecules as are homopolar. That law must ever contend for the development of isometrical molecules, so far as the currents and the conditions of existence will allow. We have, therefore, to consider isometrical forms, as the perfection of molecular synthesis. And we have even already seen that, of these forms, there must be two classes, differing eminently from each other; for we have already met species such as A and H, which have triangular equators or regions of union, and others, such as B and COC above, which have pentagonal equators or regions of union. Now, the larger isometrical molecules, resulting from the grouping of these, must be of two distinct orders.

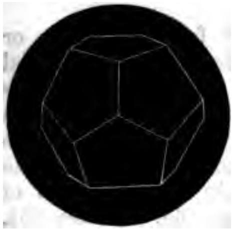

COC

62. *The Icosatom and the Tetratom.*—Where the equator or region of union in the individuals aggregating, is, as in A and H triangular or trigonal, it is obvious that the most perfect molecule or group that results from their aggregation, is composed of twenty. Viewed geometrically, it is an icosahedron, as in the accompanying figure. Thus, in Nature, if A or H, were found there, we should expect A^{20} and H^{20}, as their dense molecules.



It is to be remarked, however, that atoms of this form, may also aggregate more easily into isometrical molecules, in groups of four, thus giving rise to tetratoms, of which, moreover, it is also to be remarked, that like A, they must ever be heteropolar. We may therefore also expect A^4 and H^4.

63. *The Dodecatom and the Triatom.*—In other cases, as in that of B and COC, where the region of union is pentagonal, the typical molecule resulting from their grouping symmetrically around a common centre, must not be an icosatom, but a dodecatom; the geometrical polygon corresponding to the pentagon, being not the icosahedron, but the dodecahedron. Just as in the trigonal order of forms, therefore, we are to expect in molecular arrangements the prevalence of the number twenty, so in the pentagonal order of forms, we are to expect the prevalence of the number twelve. As we are to expect A^{20}, we are to expect B^{12}. It is not to be forgotten, however, that when so great a number as twelve cannot concur, three may unite into an isometrical group; so that in connection with the dodecatom, we may expect a triatom, as in connection with the icosatom, we



had a tetratom. While we have A^{20} and H^{20}, A^4 and H^4, we are also to expect B^{12} and C^{12}, B^3 and C^3.

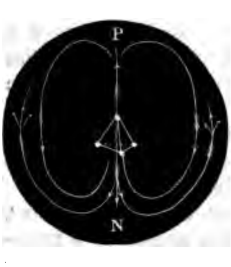
64. *Homogonal Molecules.*—The limit towards which the isometrical, under the law of assimilation, tends, is the development of a form which shall be not merely isometrical, but have all its angles constructed similarly, and of the same number of forces, and which therefore may be called homogonal. Whether we are to expect any of them in the present epoch of nature on the surface of the terraqueous globe, does not at once appear. But this appears, that molecular structures, when they have attained to such a structure, have obeyed all the three laws of Being to the utmost,—have run their course, and are ready for emancipation from nature, if not already free. (For an example, see fig. N, page 37).

CHAPTER IV.

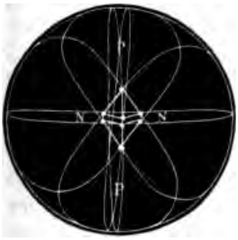
THE POLARITY OF MOLECULES.

65. *In virtue of the Polarity which emanates from them, such Regions or Angles of Molecules as are similar to each other, must repel each other.*—It is not proposed to attempt here the investigation in detail of the polarity, that is, of the currents of undulæ in the atmospheres of molecules, caused by those pulsations of the forces constituting their angles, which can never cease to actuate them, so long as they are members in the universe which is all in motion. This much may be stated as obvious, however, that from those angles which are identical in form and structure, currents whose forms and dimensions shall also be identical, will issue. But such currents will be mutually elastic or repulsive of each other (54). They will, therefore, succeed in re-entering the nucleus, only at those angles which are dissimilar to those from which they issue. And among all those angles in the molecule that are equally dissimilar, they will enter at those which are most distant from the regions whence they issue; for all motion evermore submits to deflection from the right line as little as possible.

66. *In Heteropolar Molecules, the opposite Polarites are at the opposite Poles.*—Taking A as an example of a heteropolar molecule, it follows from what has just been laid down, that the current emanating from any angle or apex, will re-enter by the centre of the base opposite, that is, the opposite pole; while that emanating from this base, or from the 3⊙ constituting it, will re-enter at the opposite pole or apex. Such molecules, therefore, realize the idea of polarity as commonly conceived, where P and N are always expected at the opposite extremities of the axis, as in the magnetic needle, a crystal of tourmaline, etc.

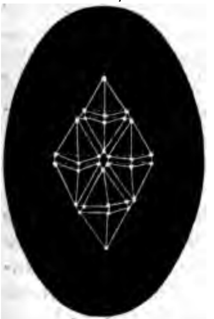


67. *In Homopolar Molecules the Polarity or Circulation of Currents is between the Poles and Equator.*—In homopolar molecules, the poles being similar, the undulæ emanating from them must be of similar dimensions, and mutually elastic, or repulsive to each other. That which emanates from one pole, therefore, cannot enter at the other pole. Except in what have been called homogonal molecules, however (that is, such as have all their angles identical), there will be other angles in the equatorial region which are dissimilar in structure to the polar angles. At the equatorial angles, therefore, in homopolar molecules, the polar currents will enter; and from the equatorial angles in such molecules the currents issuing will enter at the poles. In reference to such forms, therefore, "a polarised axis" as commonly understood, is not an axis of the form, but a terminal edge of it.



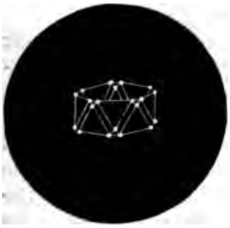
H

This condition of polarity (which is not suspected in the authorised science of the day), brings it to pass that, in the synthesis of smaller into larger, the most undecomposable chemical atoms are often composed of elements united by terminal edges, or, more generally, by equators to poles. Thus, let 5H meet in the nascent state, (or state suitable for union with one another), and free from the influence of other forms, and, consequently, under the influence of the first and third laws of Being only, they can honour both these laws in maintaining the morphological type to which they belong already, by uniting, as the condition of polarity in homopolar molecules requires them to do, viz., by their terminal edges, whence there will result the fine species $HH^3H = S$. (= ½ S auct:)



S

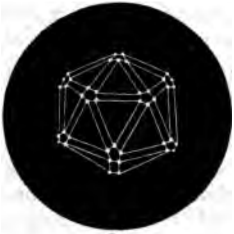
When, again, 5H unite under the same law of polarity (poles to equators), yet, so as now to cohere by a facet and not by an edge, and, under inductive influence, tending to develop a form which shall be the supplement of H or of S (that is, such that, both taken together, shall admit of a spherical atmosphere; and, therefore, such that both shall ever tend to unite; and each, when the other is absent, tend to develop it), we obtain a species, icosahedral, but with hollow poles, of which much hereafter; meantime, we may call it O (nascent oxygen).



O

68. *In Homogonal Molecules, the Currents must be simply radiant, without re-entrance into the Nuclei at all.*—If all the angles of a molecule be similarly constructed, though currents must issue in obedience to the general pulsation of molecules, they cannot re-enter within the

compass of the same molecule at all; for all such currents must be identical, and therefore mutually elastic and repulsive. They will, therefore, proceed indefinitely outwards, merely extending, as an elastic medium, the atmosphere of the molecule to the utmost, and thus giving the aeriform state. As an example of a homogonal molecule, we may adduce that which would result from the synthesis of 20 A, their apices applied to a common centre. Thence there would result an exquisite icosatom and icosahedron, N, each of its twelve angles composed of a group of 5⊙; and supposing such a molecular species to have once gained a true individuality and insulation (the aeriform state), then a volume or medium consisting of such could not unite with each other. From all the angles in each and in all, systems of undulæ must be emanating, which are of the same dimensions universally. They will not be able, therefore, to couple into currents around the molecule, and so to re-enter at the angles most remote from those whence they emanate. They must all radiate ever outwards till they become lost in the distance. And hence a volume of such molecules, supposing it to exist under pressure, must ever tend to dilate more and more, until that limit is attained when the mutual attraction of their nuclei, or that of some large body, puts a stop to a farther retreat of the particles from one another. Such molecules, therefore, can contribute but little to the economy of nature, at least in the terraqueous globe. We are not, therefore, to expect them to be numerous. And with regard to N, if we have it at all, we may plainly expect another isamorphous with it, but better conditioned as to its interior, viz., by the departure by efflorescence of the 20⊙, crowded together in the centre of N (not represented in the figure), which cannot but repel each other, and finally be off into the æther,—hence two species, not to be distinguished externally, and differing chiefly in that w = 80 in the newly developed sort, and = 80—20 = 60 in the ultimate sort. Mean w = 70 = 14H. But between these two extreme conditions of the species, there lies that in which the 20⊙ have gained the periphery, but are not gone, w = 80, (see Ph, page 40), and that in which ten are gone and ten remain, w = 70 (see Si, page 62).


N

CHAPTER V.

ON THE FORMULÆ OF CHEMISTRY.

Enough has already appeared to show that formulæ, as commonly written, will not be at all answerable to our views. It is well, therefore, that these formulæ are admitted, in so far, at least, as the arrangement of the symbols is concerned, to be perfectly arbitrary;

and it cannot but be admitted to be a step in advance, if the symbols can be so arranged on paper as in some measure to represent the molecule or combination they stand for, and be, to some extent, a diagram of it. Now, the laws of form, which have been laid down (44,45), enable us to do this, at least to a small extent. Thus, a *first* function in these laws is to distinguish between the poles and equatorial region of a molecule; a *second* to assimilate the poles to each other, and a *third* to expand or develop the body, that it may be as spheroidal as possible. And hence, in writing the formula of a substance, the letters should be distributed accordingly. Thus, the formula of carbonic acid must be to us OCO (instead of CO^2), indicating that the poles are oxygens, and the body carbon. That of cane-sugar must be to us $C\ \ (HCO)^{10}C$, instead of $C^{12}H^{10}O^{10}$, indicating a body composed of ten atoms of HCO, and poles of C, *i.e.*, a dodecatom of $C\ \ O^{10}C$, the body O^{10} covered with ten atoms of CH. The question is, whether this last conception of the structure of such a body might not be indicated in the formula by writing it in some such way as $C\left(\frac{CH}{O}\right)\overset{10}{C}$ the letters above the line indicating peripheral appendages on the body or equator. In some cases, some such mode of notation is almost indispensible; for though, in general, the formulæ of authors consisting of two letters merely, such as MO, are only half atoms to us (thus, ZnO, CaO, etc., auct: = OZnZnO, OCaCaO, etc., nobis); yet some molecules are homopolar, while yet the axis and both poles consist of but one atom. Thus, there can be little doubt that NO^5 is the true formula of nitric acid in some of its combinations, the O^5 being arranged round the equator of the atom of N (see fig., p. 57); and such a state of things (more rigidly applicable in other cases), it is almost necessary to write in some such way as $\frac{O^5}{N}$, the upper part indicating equatorial appendages. Such species are indeed in general (as will, we trust, appear,) only preliminary to *imago forms* of the same elements. Thus, $NO^5 + HO$ auct: comes out under our system as $HO\frac{O^5O^5}{NN}OH = HO,N\ \ O^{10}N,OH$, a magnificent species (see fig., page 58). Similarly SO^3+HO (not an insulable species, according to our views, if the authorised equivalent of S were really the weight of the atom), comes out (since our $S = \frac{1}{2}S$ auct:) $= S\frac{O^3}{aq}S$, showing at once its symmetry and the necessity of the atom aq to the form of the species, (see fig., p. 78).

But these things will appear more readily as we proceed. Meantime, it is impossible to conceal from one's-self that, if these views of ours are to be accepted, there is a great deal in the most modern chemistry that can afford to be forgotten,—to which, of course, the established chemist of the day will never consent. For my own part, however, I should be more happy if I knew something about HO, than if I had all the chemical knowledge and ingenuity of Charles Gerhardt.

CHAPTER VI.

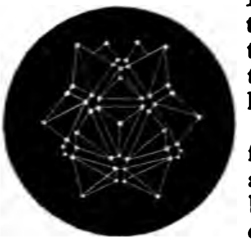
ON THE LUSTRE OF MASSES.

69. *The Non-metallic and the Metallic.*—Our first step in the synthesis of elementary forces, which has been already made, and seen to result in the genesis of the tetratom A (page 33), presents us with phenomena which correspond completely with the non-metallic and the metallic, a primary classification of material masses which is at once eminently popular, and such that science also continues to pay the greatest respect to it.

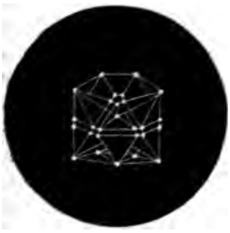
70. *Crystallogen.*—The elementary tetratoms, when going to constitute larger molecules by their symmetrical aggregation, may obviously enter into the structure of these larger molecules in either of two ways. Thus, *first*, they may enter with their apices so that the latter may lie upon the surface of the molecule, or so that they may point to the centre; or, *secondly*, these apices may stand out upon the surface of the molecule, so as to crown every triangular facet of it with a triangular pyramid. Of the former mode of composition we have an instance in COC (p. 34), in O (p. 36), and in **N** (p. 37), the beautiful molecule last mentioned, composed of A^{20}, which, could it be analysed symmetrically, would give for each polar body an atom of B (p. 33), and for the equatorial body the most peculiar form, O (p. 36) $= A^{10}$, itself also an icosahedron, as has been stated, but the five facets on both poles re-entrant, so that the form is wholly destitute of an axis. Now, whether we direct our regards to one or other of these, it will be seen that the "forces" constituting them everywhere exist in groups of 2, or 3, or 5, or 10, or 20. They are therefore all more or less dissimilar to the æther; for in it the "forces" exist as individuals and not in groups. The æther, therefore, and such molecules as these, will be dielastic, or unrepulsive towards each other (52). A ray of light, instead of being refracted or repelled from the surface of such molecules, will tend to penetrate them, and so to declare them to be diaphanous, transparent, or crystalline. Or if, in passing through, it should be stifled and lost, it would leave them in possession of a comparatively low lustre. Our first atomic species, then, A (p. 33), when entering in this way into the composition of molecules, may be called crystallogen; and we see here ground for the expectation of a crystalline or low-lustre class of bodies in nature.

71. *Metallogen.*—Again, we may have such a species as H (p. 45), or its icosatom H^{20} (fig. Ph, page 40), in which the single atoms of H are united, a pole of each in a common centre; or we may have A^{20} the atoms of A being now united, so that their bases are centrad, their apices outstanding, which gives the same molecule as H^{20} though lighter

by $20\odot$ which $H^{20} = (Ph +)$ contains in its centre; so that $Ph = N$ (p. 37), turned as it were inside out—a transformation which, as will presently appear, the mutual repulsion of the $20\odot$ existing close together in the centre, or more generally the law of efflorescence must ever tend to effect.


Ph

Similarly and in virtue of the same law, from the unification of 2B, when on the same axis, by the concurrence of the equators of both into one equator, and the opening of the constituent atoms of A at the poles, so as to render each pole pentefid; as also, by the efflorescence of O, or the turning of it inside out; we obtain k; of the same weight as S and O, (and so related to the latter, that the combination to be looked for in nature is $\frac{k^5}{O} = KO$ auct: culminating towards O $k^{10}O = 2\ (KO)$ auct: so that K auct: $= k^5$ nobis). It is a cellular species like Ph, having its cell a mould for B, as Ph has its cell a mould for N. Now, on comparing any of these species with the æther, it will be seen, that unlike the former class, their entire periphery is studded with single ætherial atoms. Their surface is similar to the æther. A ray of incident light, therefore, will be vigorously repelled or reflected from such molecules (52); and the surface of a mass composed of such will be lustrous, rising into metallic when transmission is forbidden, as for instance, by the want of symmetry, or by the density of the mass. Our genetic atom A viewed as entering into molecules in this way, that is, with its base centrad, may therefore be called *Metallogen.*


k

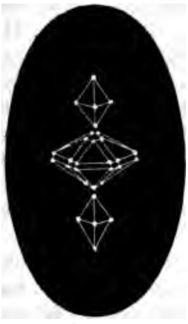
72. *Allogen.*—As to its name when considered simply as genetic, without regard to the mode of its union, since, as will presently appear, it is not insulable by itself, while yet it is genetic of a vast number of other species, it might be named *Allogen* = A. See fig., p. 33.

73. *The Non-metallic must culminate towards the Metallic.*—Wherever there are groups of forces in the interior of a molecule, as there must be in all those which are composed of crystallogens, these forces actuated by their specific heat or intrinsic mutual repulsion must, of course, drive each other from the centre. Nor will their recession cease until they have gained the extreme positions on the superficies which the law of symmetry allows. And of this, the secular effect must be along with the transition from the solid to the cellular, to produce the change at the same time from the dull to the lustrous, from the non-metallic to the metallic. And hence, throughout nature generally, the non-metallic must culminate towards the metallic.

74. *The Epoch of Transformation may often give Phosphorescence.*—In some molecules (such as H^{20}), the positions on the periphery of the molecule, for which the central group of forces, when they have gained the

surface, would normally be adapted, may be occupied by forces existing there already. It is, therefore, to be expected that the central forces, when pressing outwards, will at certain moments (increased by temperature, etc.) cause to spring into the æther those which are already occupying their places on the extreme surface. Accompanying such discharge of ætherial elements into the æther, however, may not feeble rays of light be expected to be originated? and thus the substance undergoing change to be phosphorescent? A loss of lustre and of atomic weight must accompany the change. Thus, during all the time between the moment when an extreme peripheral ⊙ is discharged into the æther, and that when the other, from the centre which drives it off, has reached up into its place, that facet of that molecule will be dull. A loss of weight will also ensue proportional to the loss of forces sublimed away. Thus $H^{20}=100$ will, through twenty diminutions of its atomic weight ultimately reach $Ph=80$, which will be the permanent weight of the species as such. Again, Ph, when exposed to intense heat, or to the presence of molecular species, greatly in want of forces to complete the symmetry of their forms, as may sometimes happen, may lose by sublimation, or discharge its extreme superficial forces, ultimately all of them; in which case its form becomes that of N, and its weight falls from 80 to 60, the species now being non-metallic in a fatal sense, inasmuch as it has existed through the epoch of the metallic, and must remain dull unless regenerated from without or transformed into some other species.

75. *The Metallic may return to the Non-metallic by Efflorescence.*—Again, it will fully appear, that a large proportion of metallic species have pentefid poles, as for instance fig. k. Now molecules generally, in the course of nature, exist in circumstances calculated to impose unity upon their axis, as well as to prolong it, when, as in the case of k, it is too short. Since, then, the 5⊙ which constitute the pentefid pole of such an atom as k can, by gathering themselves up, constitute the elementary homopolar species H, it is to be expected, that in certain circumstances, they will do so. And thus, by efflorescing on its axis with the metallic element H, there will remain instead of k, the non-metallic species C, $w=30=6H$ isamorphous with B; the combination first given to nature in this way being $HCH=CH^2$ auct: the atoms of H, however, soon to be carried off by atoms of O, which, followed by others of this universally parasitic species to take their place, give as the residuary species in nature $OCO=CO^2$ auct: Similarly, as appears from the diagrams in page 62, Ph gives ultimately $OSiO=SiO^2$ auct: another grand residuary species. (See lower fig., page 62).


HCH

CHAPTER VII.

THE LAWS OF MOLECULAR UNION AND DISCHARGE.

76. *Atoms and Molecules which are dissimilar will tend to unite.*—Being dissimilar, whether in form, structure, or size, they will be more or less dielastic (52) towards each other, whence each molecule, urged by those of its own kind (to which it is elastic or subject to be repelled) will be brought close to a molecule of a different kind; after which, the mutual attraction existing between them coming into play, they will tend to unite. This merely rudimentary law, others of a higher order must no doubt control or limit many ways; but yet union from difference must be the grand phenomenon of molecular action, both in nature and the laboratory. In its normal modes it will give three classes of phenomena.

a. Molecules differing in form will tend to unite.—Of this, the normal expression (that is, the movement in the interest of sphericity) is the union of oblate atoms with prolate atoms; under which general designations, moreover, all molecules may be included; for when viewed in reference to their atmospheres, all molecules, whatever the special form of their nuclei, are spheroidal, either prolate (axial, positive, male), or oblate (equatorial, negative, female). Thus, given H, C, O, we shall have HO, CH, CO, and CHO, etc. Already, also, two grand classes of forms have appeared, viz., *first*, that in which the regions of union and the characteristic features generally are either triangular (or hexagonal as will appear hereafter), of which A, H, and S, may be taken as examples, and which may be called the trigonal system of forms; and, *secondly*, that in which the analogous parts are pentagonal, of which B, O and N may be taken as examples. And these two orders, under the law of union by difference must tend to unite with each other, this fact sometimes conspiring with the law of sphericity to render the union more eager, as in the case of HO,CH; sometimes producing union where the law of sphericity is indifferent or opposed, as in $SO = SO^2$ auct: CHO, etc.

b. Species differing in Structure will tend to unite.—Of this, the normal expression is, that non-metallic will tend to unite with metallic, for these are the opposites of each other in point of structure. Hence given B, O, C (non-metallic), and H, Ph, k (metallic), we shall have, in some formula or other, HO, PhO, KO, CH, etc.

c. Molecules differing in Size will tend to unite.—Of this, the normal expression is, that as soon as aggregation commences, and a nucleus is formed, it will increase by the attachment of the smaller to the larger. Hence the production of the visible from the invisible generally, the process of crystallization being the type. In order to the accomplishment of such aggregation, the value of a nucleus or centre of attraction appears from this, and is well known.

77. *Heteropolar Molecules tend to become Homopolar.*—Homopolarity is the very first requirement of the law of symmetry, and that it must be of most extensive operation immediately appears, since every binary combination is necessarily heteropolar. Hence the reason why A, HO, CH, CO, are not met with in nature under the form which these symbols express, but under other forms which the following laws determine. Hence A is found in nature, as $A^5 = B$, $A^{10} = k = O = S$, HO as aq, etc.

78. *Homopolar Molecules tend to become Isometric.*—This is a simple expression of the law of sphericity. Hence A culminates towards $A^{20} = Ph$; H towards H^{20}, etc.; C towards C^{12}, while CH gives alternately $(HC)^{20}$ when the H pole is centrad (62) and $(CH)^{12}$ when the C pole is centrad (63). BO, CO, etc., can only give $(BO)^{12}$ $(CO)^{12}$, though the triatom must appear where the dodecatom cannot be constructed, *i.e.* $(BO)^3$, $(CO)^3$, etc.

79. *Isometric Molecules in the Currents of Nature and the Laboratory tend to return to the Homopolar*, i.e., *to possess one Eminent Axis.*—It readily appears that homopolarity alone is compatible with specific action, or an epoch of activity in the molecule, and this the periodicity of the world, and the course of time, everywhere tend to develop and to maintain. It is important to remark, however, that an axis may be rendered eminent, or poles may be marked either by the addition or by the subtraction of matter from some one of the axes which belong to the isometric combination; thus rendering the form prolate or positive (by addition), or oblate or negative (by subtraction), each tending under the law of sphericity to develop the other; of which a couple being thus given in each other's vicinity, they unite under the same law, and thus nature resumes her synthesis in a higher walk. Thus, the non-metallic uniting with the metallic, give such beautiful molecules as $\frac{k^5}{O}$ culminating towards O $k^{10}O = 2(KO)$ auct $Ph\,O^5Ph = PO^5$ auct: culminating towards $\mathbb{P}h\,O^{10}Ph = 2(PhO^5)$ auct: CH, in like manner, instead of giving permanently in nature $(HC)^{12}$, gives C $(HC)^{10}C = C^{12}H^{10}$ auct: $(CH)^{20}$, in like manner, gives O $(CH)^{20}O = C^{20}H^{20}O^2$ auct, or $\mathbb{O}$ $(CH)^{20}\mathbb{O} = C^{20}H^{20}O^4$, or else $OCO(CH)^{20}OCO = C^{22}H^{20}O^4$. Similarly HCO appears either as C $(CHO)^{10}C = C^{12}H^{10}O^{10}$, or HO $(CHO)^{12}OH = C^{12}H^{14}O^{14}$, etc.

80. *Supernumary Forces, and those which exist in the centre of Molecules, tend to be discharged.*—When there exist forces in a group in the centre of any combination, as for instance in the molecule A^{20}, H^{20}, or $\mathbb{H}^4$, they cannot but exert a repulsive action upon each other, unless that centre be absolutely cold, which may be nearly the case during the genesis of such molecules as H^{20}, $\mathbb{H}^4$, when constituting the nuclei of very large molecules; but which can no longer be the case when they are set free from the large molecules whose nuclei they constituted at the time of genesis. These central forces must, under the sustained action of their specific heat, secularly move towards the

periphery, and either remain there or be given off. And hence, a lessening in the atomic weight of chemical species subsequent to their genesis, thus H^{20}, when fully reduced, is lowered from 100 to 80, $Ħ^{4}$ from 32 to 28. To this process the law of the permanency of species, however, sets bounds, as it does to all the other laws of chemical action. But here we may conclude with our last inference, viz.:—

81. *All Chemical Action is a nisus towards the Construction of Molecules which shall be Spherical and Cellular.*—This follows so obviously from our principles, that it need not be illustrated. Let us only remark, that in aiming at cellularity and sphericity, and so in endeavouring to make the most of the material which has been supplied to her, Nature is aiming at that to which all pressure and every current is opposed. Hence the phenomena of nature and the laboratory are infinitely varied. All proceeds harmoniously; but absolute rest is never permitted to arrive. The attainment of her destiny is indefinitely postponed.

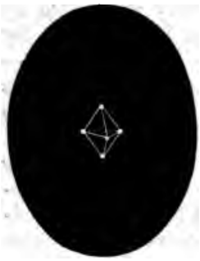
CHAPTER VIII.

HYDROGEN.

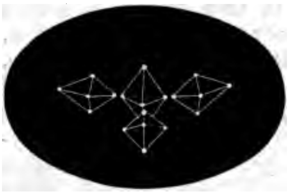
82. *The first Atomic Species A*, $w=4$ *is not insulable.*—The first atomic species A (fig. p. 33), cannot be repulsive of the same body simultaneously by both extremities of any of its four axes. It is heteropolar in the highest degree, and so related to every other molecule whatever, that if any molecule be repelled on the side of P, it will be attracted on the side of N and v. v. This species must, therefore, be an universally magnetic and parasitic element, not capable of being raised into the æriform state, or of being caught in a state of separation from other substances, as, for instance, from the walls of the vessel in which it might be proposed to collect it. As a species by itself, therefore, A will not be known to the chemist. But this very property of general adhesiveness renders it peculiarly apt for constructing other molecules; and to a few of such constructions let us now proceed, with a view to discover whether they do not represent, in a manner peculiarly felicitous, the molecules of the laboratory, whose weights and equivalents have been now so fully ascertained, as also their habits of union, and their metallic or non-metallic appearance.

83. *The first insulable Species is H.* $w=5$.—Let an atom of A then exist in the æther, or let an ætherial element in a condition suitable for union (nascent), be brought near it; this ætherial element ⊙, being dissimilar to A, they will tend to unite (76). And it might be shown by a reference to the currents which any external force, as, for instance, a sunbeam, would awake in A (as also appears at once from the law of symmetry), that the position which will be assigned to the

additional ⊙, when it enters into union with A, must be opposite the centre of one of the four facets of A at the same distance as the ⊙ already constituting a summet or pole on the other side. The original tetrahedrom thus becomes a triangular bipyramid, and therefore a homopolar form, a great step this in the interest of symmetry and stability. Its atomic weight is now 5, for it consists of 5⊙. Its structure is also wholly metallic (71). Its refractive power, therefore, must be high, and though considered apart from the operation of the law of sphericity, its form is prolate, yet under that law it may easily assume the spherical, and though its atoms may unite with each other into certain groups, because the structure is not monometric and truly homogonal (the equatorial angles, though each consisting of a single ⊙, being constituted of four, while the polar angles are of three facets), yet, when its particles are once insulated and fully invested with their atmospheres, we may expect this species to be both permanent, insulable, and eminenting aeriform. Let us, therefore, retain for it H as its designation. But, when an atom of H exists in a current or under inductive influence, such as tends to maintain or develop in H the prolate in form, while other atoms of H are nascent around, we may then expect the latter to attach themselves (according to the law of the union of dissimilars), so as to increase the matter on the equator, which (under the law of sphericity) is always defective in prolate forms. Now, in an atom of H, there are on the equator three regions for the attachment of other bodies, we are, therefore, to expect an atom of H as an axis, with three others branching out on the equator.

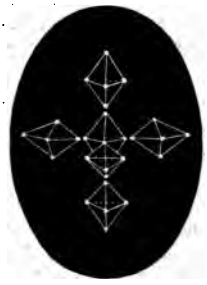


H $w = 5$.



$\frac{H^3}{H} = H^4$

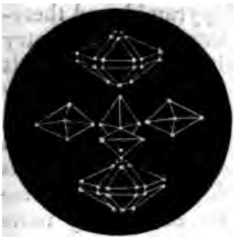
But the combination errs now on the side of oblate as much as it erred on the side of prolate before. If, then, there be other atoms of H nascent in the vicinity, we may expect another on each pole, thus giving $H\frac{H^3}{H}H = H^6$. Here, again, however, there is a pulsation too far to the other side of the sphere, and H^6 is no better as to sphericity than H^4 or H itself. Neither of these, therefore, are we to expect in nature existing alone, but only H.



$H\frac{H^3}{H}H = H^6$

The case would be different, however, if, instead of the two atoms of H last added to the poles, some congenial species could be found whose axis was so much shorter than that of H, that the combination would not be prolate but spherical; and such (p. 41) is C.

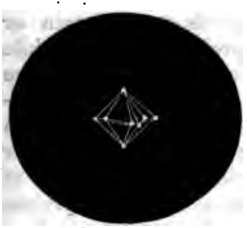
We may, therefore, expect in nature such a combination as $C\frac{H^3}{H}C = C^2H^4$. And here we have an instance of the general mode by which the activity of the molecular world is kept up, viz., by oscillations on opposite sides of the condition of repose, which is, moreover, only occasionally attainable by foreign aid, as for instance, in this case by the goodness of C coming to the relief of H— Hypnic coming to the relief of Pungent, as we might say, were it not that names refuse to change (C = Hypnic, H = Pungent).



$C\frac{H^3}{H}C = C^2H^4$

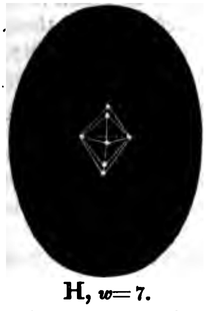
84. *The combinations of H with ætherial matter gives* Ħ *w* = 8, *and* H *w* = 7.—But to introduce other species here such as C, is to anticipate, nor is this necessary in order to develop the powers of H; for let H exist in the æther, when it is either prolate (its normal or specific form), or oblate (as it may be under inductive influence), and let the adjacent atoms of the æther be in a state adapted for union, and two combinations of H with ⊙ will result under the law of symmetry.

When H is prolate, which it may under inductive influence often be, in a higher degree than is normal to it, then just as it tended before, when atoms of nascent H were supplied, to attach 3H to its three equatorial angles, so now will it tend to attach 3⊙, one ætherial element on each equatorial angle, thus raising its weight from 5 to 8, and no doubt modifying the physical properties of H, but whether in a manner that would be discoverable in the laboratory, does not appear, nor need be inquired into, because, let but three atoms of A come on, and this species immediately reproduces H^4. We thus obtain Ħ w = 8.



Ħ, *w* = 8.

Moreover, under inductive influence, it must often fall also to H to possess an oblate form, and in this case the additions which will be made to it from nascent ætherial matter will be on the poles, so as in this way to restore sphericity to its atmosphere. In this case, however, w = 7, and we obtain H.



H, *w* = 7.

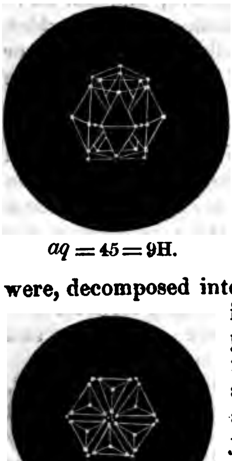
Each of these tends to develop the other.—Moreover, under the law of induction (that is, the law of sphericity operating in its own interest when union and confluence are forbidden), it follows that Ħ must tend to develop H out of H by accession of ætherial atoms, and H to develop Ħ; for oblate forms always tend to develop prolate in their neighbourhood, and prolate oblate, so that, between the two there may be the spherical. Since, then, H in becoming Ħ, must have passed from prolate to oblate, and in becoming H from oblate to prolate (for the addition in both cases is in excess of that which would have given sphericity to the resulting combination), each must tend to develop the other beside it; and generally for every atom of H that is developed in nature, we may expect an atom of H, and both abundantly in suitable regions.

All this, it must be admitted, follows naturally and easily, nay, necessarily from our grand law of sphericity. And do we not here already, in the very first lines of morphology, see the ground laid for those characteristics of form which are afterwards designated by familiar names, the one characterised by its equatorial or ventral appendages, the latter by its appendages to the extremities of the axis. We are thus led to ascribe great depth to the maxim *ab ova omnia*, as, indeed, the perfection of the Divine wisdom from eternity would lead us to expect.

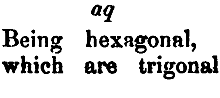
CHAPTER IX.

VAPOUR, HO, OXYGEN, WATER, ETC.

85. *From the union of* H *and* H, *common Vapour results.*—These two atoms being dissimilar, and in fact the compliments of each other, they will unite when they meet, usually coupling by their equators, as the first approach to the spherical. But the dimensions of the diagonals of the equator of the conjugated molecule thus resulting, are double in one direction what they are in the other, for that equator is rhombus; while three such couples, by union in the same way, give an equator which is a regular hexagon, and constitute a molecule that is possessed of extraordinary perfection and interest. Its weight is $(3 \times 7) + (3 \times 8) = 45 = 9H$. Its axis, instead of appearing as an ordinary axis, is as it were, decomposed into six meridional double sines. And of these, it is to be remarked, that the summits are composed alternately of one and of two elementary forces, and are, therefore, alternately metallic and non-metallic, all the rest being non-metallic and crystalline. Viewed along the axis or projected on the plane of the equator, its form is exquisitely hexagonal and trigonal in every feature, as in the accompanying figure.



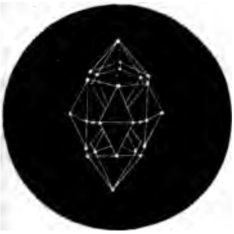
$aq = 45 = 9H.$



aq

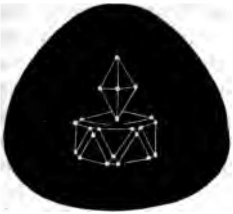
86. *Vapour may unite with H.*—But it is defective in its poles, which are re-entrant. Being hexagonal, they are also conformable to those of H which are trigonal. Where there is nascent H therefore, or

CH, or COCH, or ClH, or the like, we may expect the H to insert itself in the hollow hexagonal pole of an atom of *aq*, giving thus as the heteropolar product of the union H*aq*, and as the homopolar H*aq*H. Of these the former is not insulable by itself, and must be very active; the latter (H*aq*H), though possibly not insulable may yet be stable (when steadied by carbon or otherwise); and from phenomena and functions which will afterwards appear, it might perhaps be called single-stimulant or phyto-stimulant. In all cases in nature, however, it is to be expected to carry at least one atom of C on each pole, giving CHaqHC = C^2H^3O. More generally, COC (fig. 1, p. 34), may be expected, giving COCH*aq*HCOC = $C^4H^3O^3$, or replacing O by H, so that the polar body may be CHC, we obtain CHCH*aq*HCHC = C^4H^5O, etc. And so on, with a vast series of exquisite organics, their bodies consisting of (hydro-vapour or) simple stimulant HaqH, their poles various.



H*aq*H = O + 3H

87. *An Atom of Vapour must be Transformable into an Atom of HO.*—But a molecule so exquisitely constructed as *aq* cannot but be easily transformable. Thus, let it be placed in a current whose elements are powerfully representative at once of the prolate and of the oblate in form (powerfully positive and negative) respectively, and which, therefore, tend to resolve a spherical combination into one which may satisfy the conditions of positive and negative, and can serve for transmitting such a current; or let such a molecule as *aq*, which is, as has been said, wholly of the trigonal or hexagonal order of forms, be brought under the assimilative influence of some powerful molecule of the pentagonal order of forms, such as N (page 37), and then it is only to be expected that one atom of H, leaving the circle of six in which it exists in *aq*, and occupying the centre to constitute an axis for the combination, the other five will close up by falling into each other's embrace, thus becoming strongly cemented into a most singular and eminently interesting form already met with, and designated O (nascent oxygen, see page 36), and constituting the lower form in the figure in the margin.

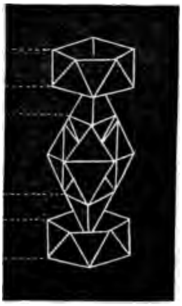


HO, $w = \begin{cases} 5 + 4O = \\ H + 8H \end{cases}$

In this transformed condition, *aq*, a form itself exquisitely spherical, is resolved into two, an axial or prolate form H, and an equatorial or oblate form O; so that now it is fit for permitting a normally constituted current of force to pass through it. The lower form O is also of the pentagonal order, while *aq* and H are trigonal.

88. *HO, according to its mode of union, must produce properties the very opposites of each other.*—In certain cases, as for instance, when uniting with *aq*, HO must have its H pole sheathed, as in OH*aq*HO, (see fig., top of next page), in which case the combination is basic,

or truly an oxide (of simple stimulant) of the form O,HaqH,O = 2.MO, since HaqH is analogous to a metal. Its poles being also already capped by O, this body will not be subject to the further action of oxygen. Nor can it unite on its poles with *aq*, but by first transforming an atom of the latter into HO. For reasons which will appear hereafter, HO, when thus combined (*i.e.*, with the O pole outstanding, and characterising it as a chemical agent), might, if a barbarous nomenclature were to be continued, be called *oxydralkali.*

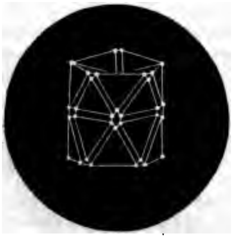


OHaqHO = 3 HO auct.*

When again uniting with such a form as N or C (page 37), HO must have its H pole outstanding, as for instance in the combination, figured in page 58, in which HO on both poles is dotted. It is now directly capable of union with *aq;* nor is it secure from the further action of O on the poles; and in this mode of combination, for reasons afterwards to appear, HO might be called *Hydroxacid.*

89. *The properties of Oxygen deduced.*—The chemical species O presents the most interesting morphological features. Like N, it is an icosahædron, but both polar regions are re-entrant or concave, so that it is wholly defective in an axis, and is altogether an equatorial, female or negative form. It cannot be worse under the law of sphericity than when existing alone. It will, therefore, be universally parasitic, adhesive, or corrosive, and a most generally active chemical agent. It is wholly non-metallic, and must have a low lustre or refractive power. Its weight is 40, and, therefore, in relation to H, it is as 40 : 5 = 8 : 1. On inspection, it will also appear at once, that it consists of 10 A, united by their apices in the centre.

90. *Difference between nascent Oxygen (Ozone?) and Oxygen Gas.*—While O must be so very apt for union generally, it appears that its own particles, when presented to each other in the proper circumstances, must unite with one another. Thus, a couple of atoms of O on the same axis, is a combination quite suitable as a nucleus for being invested by a spherical atmosphere which one atom of O is not. In a word, it follows directly under the law of sphericity, that atoms of O, in rising into the aeriform state, shall couple, so that one aeriform volume analagous to H, or to *aq*, shall consist of 2O = OO = $\circledcirc$, w = 80. Whence in order to reproduce *aq* from H and O, it is obvious that one volume of H must be taken, and half a volume of $\circledcirc$.



$2\,O = \circledcirc\ w \begin{cases} 80 \\ 16H. \end{cases}$

Since chemists can now obtain nascent O, an experiment may soon be possible which would be important as to these views. Thus, according to us, water is produced from equal numbers of H and O, which is equivalent to two volumes of H and one of 𝕆. And if the active condition of oxygen, obtained in the aeriform state from peroxide of barium, be really O not conjugated into 𝕆, then perhaps not half a volume of this gas, but a volume equal to that of H, will be required in order to the production of an equivalent of *aq*.[*]

---

* In the diagram in this page, to save labour, the leading lines of force only are drawn.

SNOW, WATER, ICE.

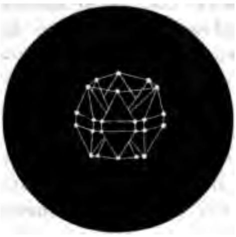
91. *There are two kinds of common Vapour.*—In reference to an atom of vapour (fig. p. 47), we find occasion for noticing a change of form analogous to the general phenomenon of maturition in nature, a change from a lower condition as to symmetry (but a higher of chemical activity), which belongs to the epoch of genesis, to a higher and more stable (but, therefore, less active state), which tends ultimately to be attained by this species. Thus, on three of the summets of the sexpartite poles of an atom of *aq*, it will be seen that there is an atom of ⊙, which is not upon the other three summets, and which, moreover, is supernumerary to the symmetry of these summets. It also appears that the translation of these six ⊙ to the equator of the molecule, would add much to the symmetry and stability of the species, the forces in the angles of the equator being in that case raised to the first square number. Under the action of its specific heat, therefore, directed by the law of symmetry, we are to expect that *aq* shall be matured into aq. And, as we have already seen, a preparation in the first

---

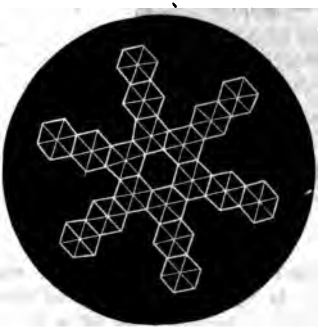
[*] *A comparison of Atomic Weights and Equivalents.*—It is not a little pleasing to observe that the atomic weights of this work, which are absolute, being the same numbers as express those of the elementary forces which constitute chemical agents (nobis), are very simply related to those of the authorised systems, though the latter are quite conventional. Thus, according to our system, which looks to symmetry as a condition of stability, not MO (as with Dalton, and authors generally), which is necessarily heteropolar, rudimentary, and not insulable, except in some molecular state, but OMMO = O𝕄O, is normal and typical, implying that the equivalents of substances, which form the bodies, or equatorial regions of compound molecules, should be taken in reference to two atoms of O or H, or such other chemical agents as are generally attached to the poles of molecules. Now, since H = 5 (nobis), and 2H = 10, while in the systems of our country, H is commonly taken at 1.0. We obtain, on this scale, the true atomic weights of basic bodies, simply by removing the decimal point one degree towards the right. Thus CaO (auct:) = 28.0 composed of Ca = 20.0, and O = 8.0, and this to us is OCaCaO = 2 CaO = 280, ℂa = 200, and 2O = 80. Such chemical agents, however, as are not basic or equatorial, but most frequently on poles such as CO^2, require to have their authorised numeral equivalent halved, in order to obtain the atomic weight. Thus, CaO,CO^2 (auct:) = OCO,OCa,OCO, or ÖC̈aC̈ (nobis), the lime is 28.0, and the fixed air 22.0 (auct:), and to us 280 and 220. But the last is two atoms, so that one, = 110, H being = 5, and O = 40.

In the continental systems, O, from its great chemical activity, having been generally taken as the standard = 100, while to us it is 10 A, by removing the decimal place one degree to the left, the number of allogens that constitute the species, is at once indicated. Hence, multiplication by four, converts these equivalents on the scale of O = 100, into ours, their halves or doubles, as the case may be. But, in the authorised systems, the entire domain of equivalents being pursued in the dark, there are not a few inconsistencies, but generally winked at, for fear of losing altogether what light there is.

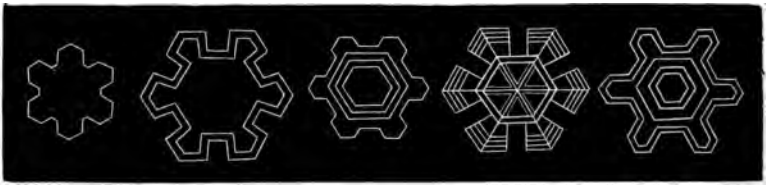
lines of molecular morphology, for the production, in due time, of differences of sex, so here, we find a similar preparation for assigning a period or epoch for organic life; in view of which *aq* might be called the vernal, and aq the autumnal form of common vapour. The terrible idea of death being derived from the spiritual world, has no place where sin has none. In the true order of the creation, instead of death after a certain period of life, there is only relief from further subjection to change—a relief arising from the accomplishment of a destiny.


aq.

92. *These two, aq and* aq, *will tend to unite when they meet.*—From the general law of the affinity and aptitude for union of dissimilars, it follows that these two sorts of vapour, as often as they meet, and the temperature permits, will tend to unite, and that by the region of their equators; for there the most complete difference exists, each angle in the one being composed of 3⊙, and of the other of 4⊙. Taking as the minimum which possesses any kind of individuality, the lowest number that has similarity in opposite regions or ends, we obtain two combinations of three elements each, viz., *aq*aq*aq* and aq*aq*aq. But these being so far from the spherical (even from the circular), and also dissimilar on their exposed parts, will also tend to unite as often as they meet; and, since in every aspect they are hexagonal, this they must do in groups of six, giving a figure like that on the margin which, on comparison with the snow flakes below,* will go far to explain the latter.



These constructions may serve also to remind the reader of the geometrical character of the inflorescence and organisation of monocotyledonous plants, in which, when compared with the higher order, the aqueous tissue predominates over the carbonaceous.

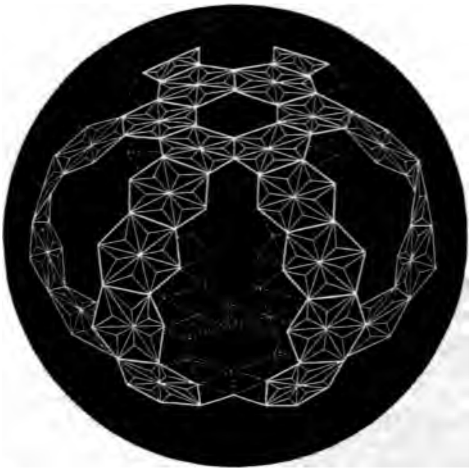


93. *Hence, cloud, snow, water, ice.*—These stellate bodies may unite in

---

* These snow flakes have not been selected for the sake of their agreement with this view. They are the first five figures in the page of those observed by Mr Glaisher, and given in the *Illustrated News*, February 17, 1855.

many ways, giving rise to beautiful large vesicles of various forms; as also the single atoms of *aq* and aq, in another way, viz., polar angles applied to equatorial angles referring themselves, the former to spherical or monometric (fine weather) forms, the latter to rhombohedral (stormy) forms, and in this way some insight may ultimately be obtained into meteorology. But all must tend to the simplest combination (which is still large), as the normal molecule; and that is, when two of the stellate bodies clap together and unite, as they may and must, under the law of sphericity, into a most exquisite molecule, of which the accompanying projection of its equatorial edges may give some idea. The smallest number of atoms of *aq* and aq, that can possibly construct it, is 36. Six in each of the meridians of which it consists. Its weight, therefore, is 36 × 45 = 1620. It is a hollow cellule or basket of dew, open on six regions, to let in full many a molecule, which may thus nestle in it as a nucleus, and thus explain how considerable quantities of certain substances may be added to a given volume of water without adding to its bulk, or, if adding, then only by the addition of new particles of water constructed out of the atoms of aq, which these saline particles formerly possessed as part of their forms.



$AQ = aq^{36} = 1620.$

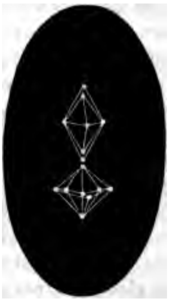
94. *A particle of water is spherical, and possesses a max. density, only at a certain temperature.*—From the conjoined action of the law of sphericity and of the currents which traverse every molecule, when changing temperature, or, indeed, when forming part of a medium which connects any two bodies that are changing temperature, it follows that a particle of AQ (= 36 aq), will be spherical only at a certain temperature; and since the sphere has a minimum of superficies, water must, at that temperature, have a maximum density.

95. *Above the Temperature of max. density its form must be oblate.*—This follows from the superior force circulating in the six atoms of *aq*, which are in contact with each other around the poles, and admit of such a current. These currents must tend to reduce the regions in which they move to a plane, and so to render the molecule oblate. Above the temperature of maximum density, therefore, a particle of water is in want of matter on its poles to render it more in harmony with the law of sphericity. And in and on the poles, therefore, though no other chemical molecule, such as C, were given, we might expect such a body as OH*aq* = 2 HO auct. But such a particle of water is no longer neutral. It has a basic reaction. It will immediately attach a particle of OCO, etc., if it can find one. In short, water above the temperature of maximum density must be apt for effecting solutions and for the construction of organic elements. When thus supplied with basic poles, a particle of water OHaqAQaqHO has its weight = 1800.

96. *Below that Temperature it must be prolate.*—When the polar currents, in consequence of the lowness of the temperature, flow along the meridians (which represent the axis) they must tend to straighten themselves, and so the particle of AQ to become prolate. Not on the poles, therefore, will matter tend to be added now, but on the equator; and what we are now to expect, if nothing but water be supplied, is, that five of these prolate particles of AQ will unite, as elementary forces do in constituting an atom of H, or atoms of H in constituting one of S, two forming the axis of the combination, and three the equator; so as to give a rhombohedral element or sesqui-combination, from which a solid, such as ice, may be expected to result.

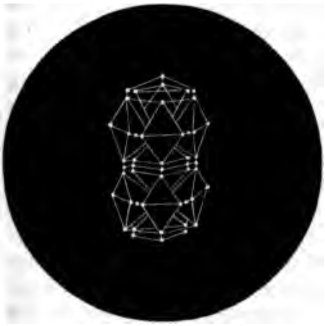
AMMONIACAL VAPOUR—ZOTE AND AZOTE—AIR.

97. *From the Union of* HH *with* HH, *or of aq or aq*H *with* aq *Ammoniacal Vapour* (= Am) *results.*—I. Although it is to be expected, that the union of H with H will usually be by their equators, whence, as has been shown (85), an atom of common vapour results, yet they are also dissimilar in their poles, and in certain circumstances, union of pole to pole may take place. Such a combination is, however, prolate in a high degree. If, therefore, it be obliged to exist alone, it may be expected to partition itself into lesser bodies, which shall be more in keeping with the law of sphericity. Now, in reference to such a process, it is to be considered that the original species implied in this combination is H, while the additional matter, being 5 ⊙, is exactly equal to the genesis of another atom of H. Under the first and third law of Being, therefore (that of the conservation of the species, and that of assimilation), we are to expect that when HH ($w = 7 + 8 = 15$), either secularly or in the sunbeam, or under the electric discharge, is (for want of others with which to unite, and so to maintain itself) obliged to partition itself, the product will be 3H ($w = 3 \times 5 = 15$).



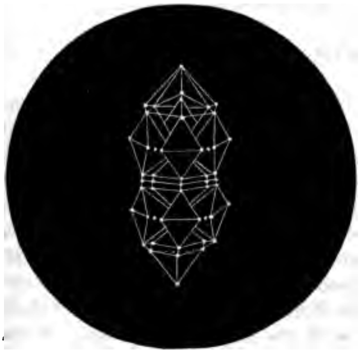
HH, $w = 15$

But in the region where H and H combine by their poles in one instance, they are likely to do so in other instances; and thus, where there is one HH there are likely to be many. And in this case, they will more readily than single atoms of H and H (for they are more prolate), couple by their equators, and these again, in sets of three, just as in the genesis of *aq*; only that under the law of union by difference, they will do so in alternately inverse positions, and thus, just as in the former case an atom of *aq* resulted, so now an atom of *am* will result. II. It is to be remarked, also, that if two atoms of *aq* (or two atoms of common vapour still in the vernal state) meet, as we have supposed two of HH to do, that is, pole to pole, they, too, can improve each other's symmetry greatly by uniting on the same axis by their summets, for their summets are dissimilar. III. Still more readily an atom of *aq*H will unite on the same axis with an atom of aq, for *aq*H is heteropolar, and must rush into union; nor can any body meet its demand better than an atom of aq.



am, w = 85 = 17H

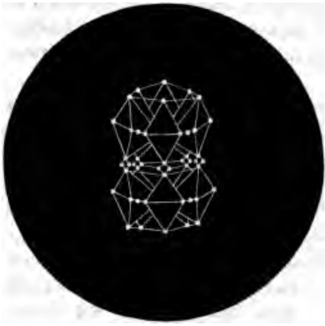
98. *Double-stimulant.*—By these modes of genesis, we thus obtain a new species, which, morphologically considered, is obviously a doubly powerful *aq*, a sort of vapour which we should expect to perform in a higher walk in the molecular world, the same function that *aq* does in a lower. Respecting the third variety, however, viz., *aq*Haq, it is to be remarked, that there are a great many "forces" in the interior; and since the poles are defective (being concave), and conformable to H, it is to be expected that when the species has symmetrized itself and acquired maturity, then, instead of one H and some supernumerary forces in the centre, there will be an atom of H in each pole, developed by the efflorescence of the axis. We thus obtain, instead of *aq*Haq, the fine species H*am*H ($w = 5 + 85 + 5$), which might be called double-stimulant. In all ordinary circumstances, however, an atom of O will cover each pole of this species, giving OH*am*HO. When, however, *am* is to enter into union with H, as, for instance, with ClH, or under any circumstances in which HO becomes or is estimated as HO, we obtain as a separate species *am*, w = 85 (= 17 when H = 1, and 212.5 when O = 100).



H*am*H

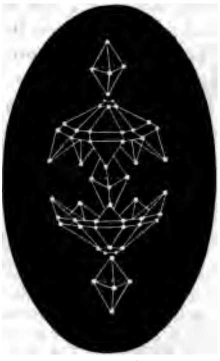
99. But of *am*, when newly generated, it is to be remarked that, when free, its axis is too long (under the law of spheri-

city) for its equatorial diameter. In the species generated from 2*aq*, therefore, we may expect that the six supernumerary forces upon the alternate summets of the poles will be often discharged into the æther, or given off to adjacent molecules, which are in want of more matter to complete their symmetry. Normally, however, they must betake themselves to the equator, raising the group of forces on each of the angles there, to the first square number, and thus giving an autumnal am, which bears the same relation to *am* that aq does to *aq*. The atomic weight of ammonia, therefore, may be expected to range between that of 2*aq* and (2*aq*— 6) = 90 to 84 (= 16.8 to 18 when H = 1; and 210 to 224 when O = 100.)


am = w, 90 = 18 H

100. Supposing it aeriform, and each of its two elements of *aq* to have retained its atmosphere of caloric, so that each limb of *am* shall occupy a double volume, its sp. gr. ought to be somewhat lighter than that of common vapour, as that of ammonia has been found to be. It will be a very powerful sort of steam, ever ready to attract atoms of *aq* around its equator, in sets of three and six, and to transform an atom of *aq* into HO for its poles, so as to be known and to act not as *am*, but as *am*HO, or, when in repose, OHamHO, that is, as oxhydralkali (88) intensified by the power of the large molecule of am, which forms its body. Moreover, when the surface of the body of *am* is fully charged with some species of the pentagonal series, as, for instance, C, it is to be expected that, under the law of union by difference, the two atoms of vapour for the poles will unite, not as HO, but as *aq*, giving a form resembling a double am, viz., *aq*am*aq*.*

101. *Ammoniacal Vapour transformable into HNHNH* (= N + 3H auct:).—It has appeared, that under the influence of molecules of the pentagonal order of forms and certain currents, an atom of *aq* must be transformed into HO (87). And similarly it now appears, that under the influence of the same order of forms (the pentagonal), and when there is a current which calls for a lengthening of the axis, am must be transformed into HNHNH. As an instance of a pentagonal form, C may be quoted. Where C rules (as in mature organic products and in the nervous system), the transformation now considered may be expected to have been accomplished; as also, when a linear force, as, for instance, a nervous current kept agoing by life, shoots along a fibre of which an atom of am is the axis. As soon, however, as this force ceases,

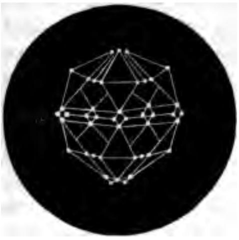

$\mathrm{Am} = \left\{\begin{matrix} \mathrm{HNHNH} \\ \mathrm{N} + 3\mathrm{H} \end{matrix}\right.$

---

* For such a combination see the figure of Piperine at the end.

or HNHNH is relieved from under the dominant inductive influence of pentagonal forms, it will, under the first law of Being, (35) as also under the inductive influence of forms of the hexagonal order, such as aq, relapse into am, and so recover itself. According to these views, however, HNHNH may be regarded as the form of ammonia in which it is smelled; for it is then altogether under the influence of some part of the nervous system, and of this system the very characteristic as compared with the other systems, appears to be the predominance of the pentagonal in form.

102. *And Decomposable into* N *and* 3H.—Let, however, either an atom of *am* or of HNHNH be exposed to any of the rude processes of the laboratory, as the electric discharge, fire, or the like, it is only to be expected that, from each such element, an atom of HH (which soon gives 3H), or 3H at once will be discharged, while the two atoms of N, each of which is heteropolar and not insulable by itself, will close together under the law of sphericity into the exquisitely symmetrical species N or **N**. And here, just as we found that in rising from the decomposition of *aq*, the atoms of O, by coupling into atoms of **O** might assume the fully individualized or aeriform state, so, plainly, may atoms of N, by coupling into N. The weight of N in all cases must be about 70, which it will be exactly, when obtained by the destruction of HNHNH, as also when otherwise obtained, as will afterwards appear (= 14 when H = 1 and 175 when O = 100). Moreover, in this species, since it is so eminently spherical, and already to a certain extent cellular also, we may expect very great stability and repose; in other words, we may expect N to prove itself in the laboratory very backward to all kinds of chemical agency. Indeed, supposing it fully invested with its atmosphere of caloric, and once raised into the aeriform state, it does not appear how it could be induced to enter into union anyhow; for it does not appear how its morphological condition could be improved in this way. It has run the course of its life. Not without reason, therefore, may such a body be named Azote. It follows, from our views, however, that one N may often exist apart from another, as one O may exist apart from another O, in which case another name besides Azote is required for it. And as such a species as N = ½N auct: cannot but be very lively and active, like O, which might retain the name of vital air, we may name this species Zote, w = 35 (= 7 when H = 1 and 87.5 when ⊙ = 100).[*]



ℕ, w = 70 = 14 H

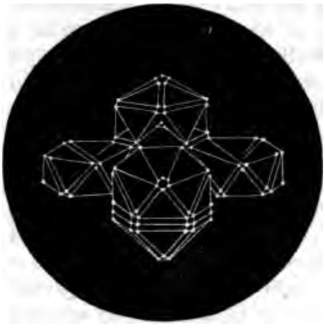
---

[*] It is here to be remarked, however, that our ℕ = N of the authorised chemistry, just as our ◎ = O of those systems which build their formulæ upon the doctrine of volumes. The chemical reader, therefore, wherever in these pages he meets with ℕ, must equal it with his own N, and where he meets with N must regard it as ½N auct. This may be troublesome for a time, but will save figures in the end. Thus, while we have HO,CH, in the systems continually, why never HN or CN, but always H^2N and C^2N? If we write it according to the view here given, the anomaly disappears. H^2N auct: = $H^2\mathbb{N}$ = H$\mathbb{N}$H = HNNH = 2 HN nobis. C^2N auct: = $C^2\mathbb{N}$ = C$\mathbb{N}$C = CNNC = 2 CN nobis.

103. *Laughing Gas.*—The lightest and simplest symmetrical combination of these two elements, N and O, is NON, which, supposing it to occupy, like N or O, only one aeriform volume, would weigh $\frac{35+40+35}{5} = 22H$, as laughing gas is found to do. Considering the greater perfection of N, however, when by itself, we may expect that this species, when placed in the presence of bodies which offer a grateful union to O (such as combustibles, or the lungs), will be readily decomposed, thus setting free atoms of O, each by itself, which we can easily believe to produce more lively effects on the nerves than atmospherical oxygen, in which the atoms of O are inhaled in the coupled state, and invested by their atmospheres of caloric, as they are also in oxygen gas, when artificially prepared and inhaled.

104. *Eudiometer Gas and its products.*—The next symmetrical combination which offers itself is ONO ($= NO^2$ auct:), to which we must allow two aeriform volumes, since we have here one volume of azote and one of oxygen. Hence, sp. gr. $\frac{40+70+40}{5} \div 2 = 15\,H$ as given by experiment. This combination is, however, too long in the axis; and, therefore, if more O be supplied, we may expect ONO + O first to open into ON+NO+OO, and then to symmetrize itself into 2 (ONO), of which sp. gr. $\frac{40+35+40}{5} = 23H$, agreeing with experiment (which NO^4, the formula of this species in the systems, does not, without division). This ratio of the two elements N and O, however, culminates towards the fine form $ON\frac{O^5}{O}NO = 2\,(NO^4)$ auct: which is the fully oxygenated form of $N\frac{O^5}{O}N = 2\,(NO^3)$ auct: fine species these, which have of late been made to show themselves in organic chemistry.

105. *Nitric Acid.*—But all these large molecules are aberrations from the type which is a dodecatom (the polyhedron proper to the pentagonal series of forms), its poles azote, its body oxygen, viz., $N\,O^{10}N = 2\,(NO^5)$ auct. Suppose N, indeed, and not $\underset{\smile}{N}$, to be the agent uniting with O, then, since around the equator there are just five regions for union, we shall have $N\,O^5N$, a very exquisite form; and this may occur in nature (if any of our molecules do). But all such forms (of which there are many, as will appear) must tend to couple into dodecatoms; in this instance into the grand molecule $N\,O^{10}N$, which, though we cannot expect it by itself in nature, being composed entirely of non-metallic elements (76b), yet we may expect in combination with

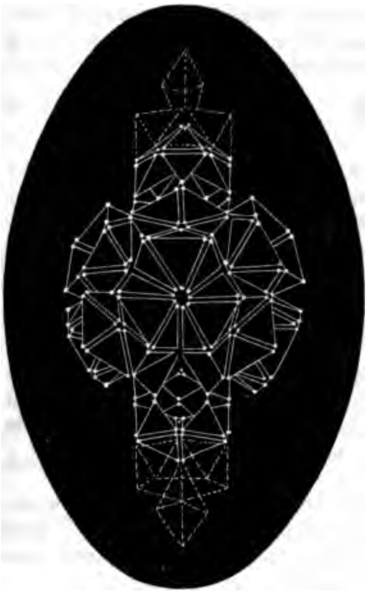


$NO^5N = NO^5$

metallic matter, such as potassa, etc., or even in the laboratory, perhaps with an atom of HO on each pole, giving the exquisite body $HO\,N\,O^{10}NOH = 2\,(NO^5 + HO)$. And here, supposing this species to form a liquid by itself, it follows, since its poles consist of atoms of H (which are trigonal), that the first isometrical molecule that is possible, is a tetratom (62) which is the densest we ought to expect in a species, all whose elements tend to be aeriform. Allowing one aqueous volume to such a molecule, we obtain sp. gr.:

$$= \frac{4\,(HO + N + O^{10} + N + HO)}{AQ} = \frac{4\,(45 + 70 + 400 + 70 + 45)}{1620} = 1{\cdot}55,$$

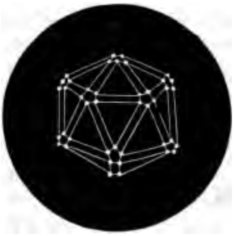
expt. id.



$HO,N\;O^{10}N,OH = 2\,(NO^5 + HO)$

THE ATMOSPHERE.

106 *Azote may be useful to protect O from the insidence of H, when aq is decomposed into H and O.*—From what has been shown of the delicate cellular structure of a particle of water (93), it fully appears that it cannot exist if either its own temperature or the pressure upon it exceed a certain amount, and there exist any mechanical agitation at all in the region of heat or pressure. In either case, AQ will be resolved in 36aq (*i.e.*, a particle of water into a large volume of vapour or steam), of which, in its confinement, if adequate heat be present, the explosive force and violence may exceed all bounds. In that primæval abyss, therefore, to which antiquity on all hands refers us, we may calculate upon the existence of high-pressure steam in a state of confinement, and therefore of ebullition in its depths, though we are not to look for any indication of it at the surface. But, in such a state of things in the abyss, there can be no doubt that much *aq* will be transformed into HO, as also much *am* into $N + HH$. Now, although as soon as these elements shall have escaped from the region of violence, and while yet in the deep, *aq* and *am* will be regenerated from them, yet, deeper down in the laboratory of the abyss, where N and O cannot but meet occasionally, we are to expect various unions to take place between them, among which there first appears NON; *i.e.*, an atom of O, with both poles filled and covered up by an atom of N. But by this an atom of O is obviously secured from the access of H, and, consequently, from relapse along with it into an atom of *aq*. Now NON, although, in consequence of its very highly prolate form, it might not be able to exist alone, yet might it



N

do so in the molecule proper to its form (which is pentagonal), that is the dodecatom; and so solid a form is this dodecatom $(NON)^{12}$, that it might exist under great pressure. The utmost, indeed, that any pressure could be expected to accomplish, would be the locking together of the single atoms of N, so as to give instead of N the compact icosahedron N; thus giving as the profoundest abyssal combination NON, or rather, let us say, NON as one species (and which may partition itself also as BoO,N,OBo, of which hereafter.)

107. *Common Air.*—Returning at present to NON, however, and its molecule, it is to be expected that when it escaped from the region of pressure in which it was generated, its partitionment will take place; and ultimately the atoms of N will be liberated, for they are more perfect each by itself than any combination of them can be. We thus obtain as material for an aeriform medium over the abyss, a supply of 2 N + O. It has been shown, however (90), that atoms of O do not assume the aeriform state singly, but in couples = 𝕆. Our mixed atmosphere will, therefore, have for its element 4 N + 𝕆. But does this exact ratio satisfy the law of symmetry? On constructing the smallest integrant portion or cube of air, that is, the cube which has 4 N for its side, and whose number of atoms of N = 64 and of 𝕆 = 16, it will be found that, to complete the symmetry of the distribution of the atoms of 𝕆, another will be required for the centre of the cube, giving as the ultimate or perfected composition of the permanent atmosphere, which, under the law of symmetry, may be expected to extend to all accessible heights above ground.

		Vol.		Weight.		
4 × 4 × 4 = 64 N	=	79·01	=	76·71	. . . 76·99	Boussingault and
(4 × 4) + 1 = 17 𝕆	=	20·99	=	23·29	. . . 23·01	Dumas, 1841.*

The production of the atmosphere, according to the mode of genesis, which has now been conceived, implies the escape of an atom of H for every atom of O; and of this hydrogen we may expect a portion to gain the atmosphere. There, however, it will ascend, and when on high, being most favourably placed for the union of aetherial matter with it, from H we shall speedily have H and H, and, consequently, *aq* and aq (85·91), and this as occasion serves gathering in AQ, will give rain, and so be returned to the earth. It appears, however, that HH and *am*, though in comparatively very small quantities, may also be expected, so that not only vapour but ammonia may be said, in our theory, to attach organically to the atmosphere.

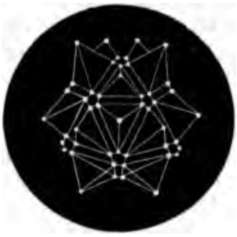
---

* And thus we find our divisor for the specific gravity of aeriforms, common air being unity.

64 ℕ = 64 × 70 = 4480
17 ◎ = 17 × 80 = 1360
81) 5840 (72·1 = w of an imaginary unit volume of dry common air.

CHAPTER X.

PHOSPHORUS, SILICON.



Ph, w = 80 = 16 H.

108. Deep in the abyss, much H may remain, and under the pressure existing there, may be forced into the molecules proper to its form. These, as appears at once from its triangular equator, are the tetratom, hexatom, octatom, decatom, and icosatom, of which the last is by far the most perfect, and that which solicits our regard here. Its weight at the moment of genesis, is $H^{20} = 5 \times 20 = 100$. There are, however, in the centre, 20 forces crowded together, and these must ever tend to repel each other and to gain the surface. But the positions proper for them on the surface, are already occupied by twenty similar forces. The latter are, however, resisted on the outside by the æther only. Under the pressure outwards, therefore, of the forces in the interior, those on the surface will be thrown off or vaporize into the æther, meanwhile rendering the species phosphorescent (74), destroying its metallic lustre, and reducing its weight from 100 to 80 (the latter = 16, when H = 1 and 200, when O = 100), which, during the most philosophical period of modern chemistry, was the favourite weight of an atom of Ph, though now it is more generally taken at double this number (= Ph nobis).

109. But not in the abyss only, and as a mineral, are we to expect this species. H abounds in organized bodies, and there are there many icosatomic molecules having H poles centrad. Now, the centre of a large molecule must be a region of intense cold; for the specific caloric, so far as the molecule possesses unity, must ever seek to diffuse itself as an atmosphere over the periphery of the molecule. Cold, in this case, therefore, may do for the group of 20H, what the pressure of the abyss did in the other, and in living bodies as well as in the strata, we may have this molecule H^{20} unified and simplified into Ph. Nor are these the only modes or regions in which this species may be generated. Thus, 20 metallogens, by normal union, give it at once. Ph may, therefore, be also a meteoric species, as well as a mineral and an organic species. Moreover, BoOoB (the boracic principle, undecomposably united with O, see fig. N, p. 37), if simply effloresced, gives it. In short, we may look for Ph in every region of nature, although that it will be only found in small quantities during any one epoch, will presently appear.

110. Its atoms are so well adapted for locking into each other,

especially when solicited to union by O, that it is to be expected, that in the current of nature and the laboratory, they will generally be found locked together in couples. Such coupling is, in fact, as good to them as chemical union, for when they couple, the region of union becomes in reality an atom of O, and, therefore, not only an equatorial region well suited for the attachment of other matter, but so much non-metallic matter for the species, which, however defective in lustre from phosphorescence or otherwise, is (nobis) truly metallic. Thus, we obtain the equivalent of phosphorus now generally adopted. And here, again, we find, as in reference to N auct : = N nobis, so Ph auct : = Ph nobis. Two such couples united crosswise, will (as we supposed the elementary forces themselves to do (59), in order to constitute an atom of allogen), give an isometrical molecule which may possibly be raised into the aeriform state, in which case sp. gr. $= \frac{4 \times 80}{72 \cdot 1} = 4 \cdot 439$. Exp. $4 \cdot 355$.

111. But what will be its structure in the dense state? Its normal molecule, like all elements of the pentagonal system, is the dodecatom. But a dodecatom is very small in volume compared with a particle of water, which, however, it has been shown, that every dense molecule must emulate. A dodecatom of dodecatoms, again, would be vastly too large. But between these, and belonging also to the pentagonal series of forms, as has been shown, there is the triatom, and in reference to this it is a very remarkable thing, that a triatom of dodecatoms gives the very number of elements which exist in a particle of AQ. It appears reasonable, therefore, under the law of assimilation, that as often as these forms will admit of it, we shall have dense molecules consisting of triatoms of dodecatoms. Calculating the weight of phosphorus on this theory, we obtain

$$\text{Sp. gr.} = \frac{3(12 \text{ Ph})}{\text{AQ}} = \frac{3(12 \times 80)}{1620} = 1 \cdot 77 \text{ Expt. id.}$$

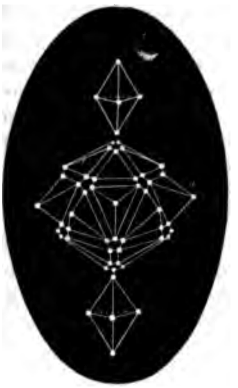
It may also be observed, that in such cases, since $\text{AQ} = 3 \times 12$ aq, the same result is obtained by dividing the simple elements by aq : thus, $\frac{\text{Ph}}{\text{aq}} = \frac{80}{45} = 1 \cdot 77$.

112. Being of a metallic nature (though from being hollow, and its surface in a state of change, we may suppose that it may be now translucent, now opaque, and generally defective in lustre), it will have a great demand for O. Those combinations which are most natural and stable, however, will be such as are analogous to NO^5N, and $\text{N O}^{10}\text{N}$, and $\text{N} \frac{\text{O}^5}{\text{O}} \text{N}$: that is, PhO^5Ph, PhO^{10}Ph, and $\text{Ph} \frac{\text{O}^5}{\text{O}} \text{Ph} = \text{PhO}^5$, $2(\text{PhO}^5)$, and $2(\text{PhO}^3)$ auct :

113. These being dissimilar will unite. Hence PhO^5Ph, PhO^{10}Ph, and a conjugated acid $= 3(\text{PhO}^5)$; and hence, in the laboratory, three phosphoric acids, the ratio of O in all $= 55 \cdot 56$ per cent., and their respective equivalents, as $1 : 2 : 3$; whence, estimating them all as of the same weight, the equivalent of water or other base in union

will seem, after some manipulations, 1, after others 2, after others 3; and these phenomena will be constant when the conditions of existence are the same.

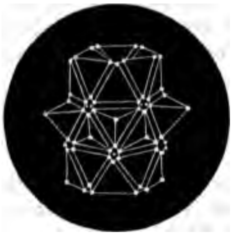
It does not appear, that an *individual* of these species, or of Ph itself, can be permanent in nature, though the *species* will. Thus, in such a current as insists upon simplicity of poles in molecules, and unity of axis, an atom of Ph must gather up the five forces which form its pentefid poles into an atom of H on each (see accompanying fig.) And these atoms of H on the approach of O must unite with O giving *aq*, (75) and there will remain a new species with oxygen poles, and metalline body, viz., OSiO (see fig. below).



$HSiH = 5 + 70 + 5 = Ph$
$Si = 70.$

SILICON.

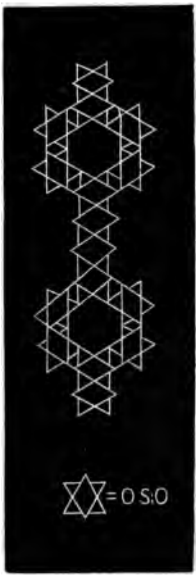
114. Not merely by the degeneration of Ph, must this species result. It must be a most abundant product of the abyss in a direct manner. Thus, it might be shown, that in the abyss from the transformation both of *aq* and *am* when O is present, we may constantly expect the remarkable combination NO. Thus, an atom of aq consists of a circle of six elements of the general form of H, and let aq be normally decomposed, as by the galvanic current, nothing but an atom of H, and the symmetrizing of the remaining five into an atom of O, which is the counterpart of H, is to be looked for; as also whenever aq is normally transformed. But let an atom of aq be decomposed in the presence of an atom of O pressing upon it, and it is to be expected, that while one atom of O tears out an atom of H from aq, and by carrying it off itself regenerates another atom of aq by the use of this atom of H, the five remaining elements of the atom of aq, instead of forming into an atom of O, will rush simultaneously into the pole of the remaining atom of O, and thus form an atom of N in union with one of O. But such products of the abyss are heteropolar, and will not exist single. Let but a couple meet, however, and then the atoms of N locking together by their pentifid poles under the pressure, we obtain the solid sort of azote (N p. 37), carrying O on each pole. We obtain ONO. Now, this is plainly the counterpart of NON, which we found to be the abyssal element that gives the world its atmosphere. This species, therefore, which is the counterpart or complement of air, we may as usual expect most abundantly, at least, in a mature state. As to its maturition, what we are to expect is, that the ten ætherial forces which are grouped together in the centre shall find relief by mutual



$OSiO, w = 150 = 30H.$

repulsion in the direction of the equator, to which the presence of an atom of O on each pole, and the consequently prolate form of the entire combination will determine. The central body will thus be transformed into a new species; the same as that which we found to result from Ph, and the same in weight as N, and not without analogy to both; but with its body now metallic instead of crystalline, as it is in N; and the atoms of O, now belonging to its genesis, and in balance with the metallic parts most firmly attached. Instead of designating this mature (cellular and metallic) species N or Ph, let us, therefore, designate it Si, and the natural combination of O with this new abyssal species OSiO. Its molecule, like that of pentagonal forms, generally is of course $(OSiO)^{12}$. But after existing in the current of nature, two poles, as has been shown (79), must be marked upon it. Let this be done by the union of two additional elements on opposite regions of the dodecatom, we thus obtain $OSiO\,(OSiO)^{12}OSiO$. But, in this molecule, both poles are negative, and both are similar, while the currents of the terraqueous globe are heteropolar, the one positive and the one negative. Under their influence, therefore, we may expect that one of the negative poles of the molecule just constructed, will be filled and rendered positive by the introduction of an atom of Si into it. But no sooner shall we have such a molecule with a positive pole, but it will immediately couple with one of the former sort both whose poles are negative, thus giving as the unit of this abyssal species on the grand scale $OSiO\ (OSiO)^{12}OSiO(Si)OSiO\ (OSiO)^{12}OSiO$. Allowing one aqueous volume to such an element, we obtain as the sp. gr. of this grand product of the abyss,

$$\text{Sp. gr. } \frac{150+1800+150+70+150+1800+150}{1620} = 2{\cdot}68 \text{ (Expt. id.)}$$



Supposing that the chemist could decompose it, he would obtain O = 53·3 per cent., and Si an imperfectly metallic body, w = 70, and that of $OSiO = SiO^2$ auct: = 150 (= 30, when H = 1, and 375, when O = 100), which is as nearly the authorised equivalent of silica as need be cared for. It further appears that this species, since every molecule is testudinated all over by oxygen, will be secure from the attacks of oxygenating agents; and, therefore, of chemical agents in general. Supposing its molecules to be triatoms, its system of crystallization must be rhombohedral.

A series of molecules united by their terminal edges must give rise to a spiral arrangement, leading us to expect the phenomena of circular polarization, etc.

And here, adopting a simpler diagram to represent OSiO (that is, as it were, a section of it in the plane of the axis), we obtain an exquisite element of crystalline and organic nature, in which, however, as formularized above, there are, for the utmost solidity, obviously 4O too many. Supposing these removed, as in the diagram, we obtain oxygen 50·6 per cent. sp. gr. = 2·54.

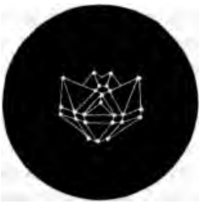
And here already we have, as is well known, the element of the skeleton in certain animals and plants. In the relations of the lines of force in the diagram, it may also be seen why the rhombohedral and hexagonal crystalline forms attach to the species.

CHAPTER XI.

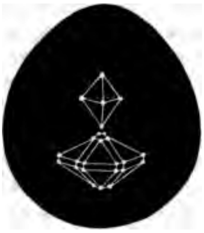
CARBON.

115. N *like k* (see p. 41) *in certain cases will be transformed into* C + H.—The primary combination from which, according to the preceding view, silex is obtained, is NO. This, however, to settle down as silex, must conjugate, so as to give ONNO, which, under pressure, gives ONO and by efflorescence into the cellular and metalloidal OSiO.

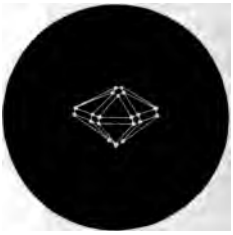
If NO remain single, the result must be very different. Thus, NO is heteropolar, and the N pole is pentefid. Whenever, therefore, a force bears upon NO, whose action is to give unity and length to the axis (and especially in the presence of O, which is always favourable to the regeneration of HO, and therefore to the development of H), it is to be expected that N (see first fig.) will gather up the 5⊙ which constitute its pentifid pole, into an atom of H (see second fig.), thus leaving as a form to which H is attached, a beautiful pentagonal bipyramid, generally isamorphous with B (p. 33), in which w = N—H = 35—5 = 30 = 6H, which, therefore, we may designate by C (for another genesis of C, see 75).



N = 35



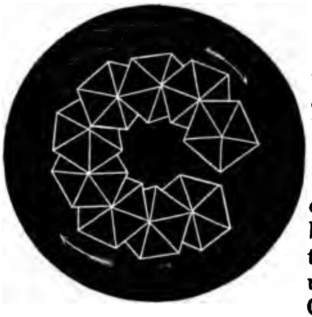
CH = 30 + 5



C = 30 = 6.H

116. *The Spiral Filament.*—The polar and equatorial angles in this

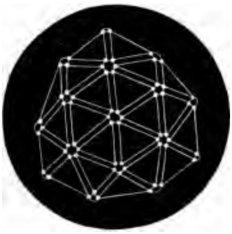
species being dissimilar, atoms of C, when they meet successively, will unite by their terminal edges, and, from this, there must result a helix of indefinite length, ten atoms of C in one turn or spire, producing in solutions circular effects upon rays of transmitted light; and spiral filaments in structures of which C determines the organisation.



117. *Charcoal.*—Under the ordinary condition, however, that every combination tends to acquire individuality, these spiral filaments must tend to return upon themselves, and thus the uppermost C instead of ascending further, to turn downwards. But, one spire so doing, gives the molecule-proper to the form of the species, that is, the body of a dodecatom, which may be thus represented, $(C)^{10}$, $w = 300$, which cannot but be a radical of great importance, in which polar species, such as HO, HC, HOC, etc., etc., may attach themselves.

118. *Diamond.*—Under circumstances of peculiar repose also, the dodecatom may construct itself completely, or may be left as a nucleus when all the oxygen, hydrogen, etc., have been driven off, or carried away from the molecules generated in carbonaceous tissues. And in this case, we obtain a molecule of such exquisite structure, that it reminds us of the ætherial element itself. It displays, indeed, traces both of the tetrahedron and of the sphere; and it does not appear how it could be surpassed by any body in mechanical strength and hardness. As we found, then, in reference to the æther, the tetratom to be its first molecule, so let us assume the tetratom in this case, as also that these tetratoms of C^{12} combine again in tetratoms of a second order, each of which is now large enough to occupy an aqueous volume. We thus obtain

$$\text{Sp. gr.} = \frac{4(4 \times 360)}{1620} = 3.55 \text{ Expt. id.}$$



C^{12}

119. *Hydrocarbons.*—According to our views of the genesis of C, however, whether from N or k (see p. 41), it makes its first appearance in Nature in union with H, and this, therefore, under the first law of nature, we are called upon to infer, will tend to be its last. Accordingly, even oxygen, though exquisitely conformable to carbon, so that it cannot but be most greedy of union with it, cannot prevent the return of carbon into union with hydrogen, but by keeping it covered up, as in OCO, either afloat in the atmosphere, or fixed on the poles of some powerful metallic species, such as lime. In all

the kingdoms of nature, hydro-carbons show themselves, and tend to accumulate, even in spite of the oxygen of the breeze, or of respiration. The chemist also can produce new sorts of them in vast numbers. As to CH, being heteropolar, it can be insulated only in the molecular state. Hence the chemist is in possession of it in its tetratoms (isometrical but not homopolar), giving $(CH)^4 = C^4 H^4$ auct: Then, whether he have HCCH or not, he has its tetratom $(HCCH)^4 = C^8 H^8$ (Sp. gr. = ·7. Cahours), to which the admirable Faraday, who presses so closely yet so modestly on the footsteps of Nature, has long ago added $(CH)^{12} = C^{12} H^{12}$, in what remains of the oil gas liquor when the others have risen.

120. *Naptha.*—But, in the current of nature or art, as has been shown (79), poles must be marked on an isometrical molecule. And here, marking them as is most legitimate, by the omissions of so volatile an element as H; and then forming the dodecatoms into triatoms, as usual, in order to obtain a molecule, consisting like a particle of water of thirty-six elements, and large enough to occupy the same volume, we obtain $3(C\left(\frac{C}{H}\right)^{10} C) = C^{36} H^{30}$, Sp. gr. $\frac{3(360+50)}{1620} = .76$. Expt. id. (Best Persian naptha.)

121. *Coal.*—To preserve all the atoms of H in a dodecatom, each must be capped by an atom of C. But now the combination is no longer capable of the aeriform state. Doing this previously to its reduction to naptha, and bringing the triatom of dodecatoms into harmony with a sub-ærial genesis, by allowing an atom of N and one of O to attach to each of the three molecules of which the triatom consists, we obtain $3\,(O\left(\frac{CH}{C}\right)^{12}N) = 3\,(C^{24} H^{12} NO)$, which quite agrees with the analyses of the best coal by Richardson and Regnault; Liebeg taking HO for NO, as the polar body we obtain his actual formula for Newcastle coal, viz., $C^{24} H^{13} O$. Of the species here defined: Sp. gr. $\frac{3(720+60+35+40)}{1620} = 1.58$ Expt. 1.3—1.75.

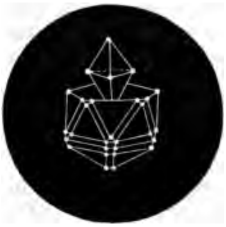
122. *Fats and Oils.*—As mineral nature gives napthas and coals, so does organic nature give oils and fats, the poles being here variously marked of course, and so giving rise to many species. The radicals of all, however, are $C\left(\frac{H}{C}\right)^{10}C$ when C is centrad, and $\left(\frac{C}{H}\right)^{20}$ when H is centrad in the molecule. Of these the triatoms give C^{36} and C^{60}, and one of each C^{32}, and so on by union in this way as in nature. But both the dodecatom and the icosatom must also be subject to incrustation by successive layers of CH, so that they shall become double, triple, etc.; which may also be regarded as the molecular states of the hydrocarbons C^2H^2, C^3H^3. The most perfect species which presents itself for theoretical construction is, an icosatom of triple hydrocarbon, its poles carrying on the same axis, 4 C + 3 H + 3 O + aq which admit of representing manifold important radicals, as for instance, the saccharine and the lactic, thus

$$aq\text{, HOC,HCOCOCH}\left\{\begin{matrix}\text{CH}\\ \overline{\text{CH}}\\ \overline{\text{CH}}\end{matrix}\right\}^{20}\text{HCOCOCH,COH, }aq = \text{C}^{68}\ \text{H}^{66}\ \text{O}^{6}$$

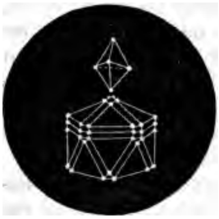
$+ 2\,aq =$ Margaric acid (triple fat with lactic, saccharine, poles).

A volume, however, would not be sufficient to demonstrate all the easily constructed forms of the fat bodies; let us, therefore, fall back upon the simple combinations just referred to, and exhibited all perhaps occasionally upon the poles of the beautiful chemical obtained from human fat, etc.

123. *Sugar—Sweetness.*—From various regions of nature both dense and aeriform, water in the basic condition, seems competent to attach pure carbon. An atom of C on each pole of a particle of such water, gives C,OHaqAQaqHO,C, and consequently the combination COH or HOC. And here we are introduced to a radical full of the promise of molecular activity; for not only is it heteropolar, and must ever aim at the molecular state, but in it the H is still separated from the C by an atom of O, while by the first law of Being, (the principle of the regeneration of the original combination), the H and C must tend to come together. The inversion of the part CO is therefore to be expected, thus giving HCO as the mature form of HOC, a combination which, in its functions, must have analogies to HO, since it differs from it only by the insertion of an atom of C between H and O. And here we might venture a conjecture as to the possible cause of such a sensation as that of sweetness. Suppose there existed in the sentient organisation of the tongue, molecular parts in the state of HOC, whose destiny in the order of nature, is to be transformed into HCO, it follows, from our third law of Being, that the access of particles of HCO to these sentient parts, will facilitate and tend to effect that change in the organisation. Now, such a change being the fulfilment of their destiny, we may suppose, to be agreeable or sweet. The molecular form proper to HOC and HCO, as in the hydrocarbons already noticed, is either the dodecatom or the icosatom, leading us to expect in nature two genera of sugar, as for instance, from the dodecatom $\text{C}\left(\frac{\text{HC}}{\text{O}}\right)^{10}\text{C} = \text{C}^{12}\text{H}^{10}\text{O}^{10}$ or $\text{HCO}\left(\frac{\text{HO}}{\text{C}}\right)^{10}\ \text{OCH} = \text{C}^{12}\text{H}^{12}\text{O}^{12}$ etc., vegetable sugars); and from the icosatom $\left(\frac{\text{OC}}{\text{H}}\right)^{20} = \text{C}^{20}\text{H}^{20}\text{O}^{20}$, etc., etc., (milk sugars) etc., with poles variously modified.



HOC

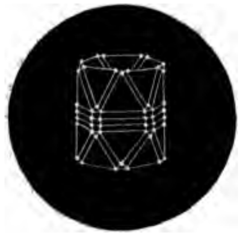


HCO

124. *Vegetable Acids and Jellies.*—During the change from HOC to HCO, it is easy to understand that the H must often escape leaving CO (carbonic oxide), a combination, not insulable or aeriform by itself, but as COC occupying two volumes; capable also of

the molecular state, giving $CO\left(\frac{O}{C}\right)^{12}OC = 2(C^7O^7)$, (rhodizonic acid.) But such a quantity of C and O without H, is quite unnatural. There is an approach to nature in $H\left(\frac{O}{C}\right)^{10}H = C^{10}H^2O^{10}$ (croconic acid). But, before Nature will sanction the combination, we may expect HOC as the polar bodies, and C^{12} complete, to which, adding an atom of aq on each pole, we obtain $aqHOC,C\left(\frac{O}{C}\right)^{10}C,COH\,aq = C^{14}H^4O^{14}$ (meconic acid). But we must also have many acids of a very elementary structure. Thus, an atom of saccharine, HCO, may be protected from immediate destruction from the oxygen of the air by an atom of CO on the H pole, thus giving OCHCO, whose most perfect molecule is, of course, the dodecatom. Marking the poles by an atom of aqHO on each, we obtain $aqHO(OCHCO)^{12}OHaq = 2(C^{12}H^8O^{14})$. This fine species, however, may exist also in triatoms, as also in single atoms. By inversion of one of the constituent elements also, it becomes HCOCO, not only capable of dodecatoms like the former, but of tetratoms $(HCOCO)^4 = C^8H^4O^8$; and icosatoms; as also of two organic forms; one with a body of HaqH (single stimulant), the other with a body of $\frac{H^3}{H}$ (marsh gas). And thus it becomes easy to understand how there may be many acids, such as citric, malic, maleic, fumaric, etc., not to be distinguished by their combustion or equivalents, while yet they are very different in themselves, and in the functions which they serve in nature and the laboratory. So long, however, as long continued boiling, etc., with powerful agents (oxide of lead, etc.), are employed, there is but little hope of isolating the very bodies which nature produces.*

125. *Carbonic Acid.*—But HCO will not be able in any but in the most compact molecular state, to withstand the oxygen of the atmosphere; let but an atom of O have access, one of its elements will carry off the H, regenerating aq, and the other perching on the atom of C, for which the central cavity in O is just a mould, we shall obtain a remarkable species, viz., a particle of oxygen gas, carrying about with it a particle of C concealed in its interior, its formula OCO. Hence, we may expect this species to be parasitic like O,



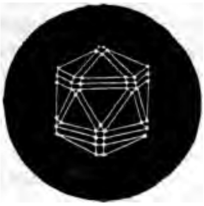
$OCO = CO_2$

---

* The value of a chemical formula, to assist in giving insight into structure in such cases, is beautifully shown by Fremy's researches on the vegetable jellies. Thus, suppose an icosatom of the acidous element HOCOC to receive a dodecatom of the saccharine HCO on each pole, which is such a combination as might be looked for where organic forms are still touching on inorganic, we obtain $(HOC)^{12}(HOCOC)^{20}(HOC)^{12} = C^{64}H^{48}O^{64}$, which is the first articulate form Fremy obtains from the jelly-producing substances, while the same, when dissolved and organised around a body o phyto-stimulant (HaqH), gives two tetratoms, or one octatom of the fine form $(aqHC\frac{(CO)^6}{HaqH}CH)^8 = 8(C^8H^5O^7 + HO)$. Fremy's metapectic acid (which, when free, will obviously have an atom of aq on each pole).

and entitled to such a name as fixed air, also, its combinations (carbonates) to be generally analogous to those of oxygen (oxides), and a place for it possible where there is a place for oxygen, as in the blood, etc. It is obvious, however, that its functions, especially in relation to carbon, must be very different. Sp. gr. $= \frac{40+30+40}{72.1} = 1.525$ (Expt. 1.5241—1.529 Regnault). Its regions of union being pentagonal, its condensed molecule must be the dodecatom, Sp. gr. $\frac{12(40+30+40)}{1620} = .81$ Expt. .72—98, according to temperature.

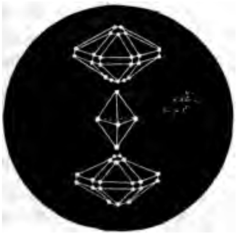
126. *Styptic.*—The most independent way in which CO can attain to homopolarity is that, in which it attains at the same time to the most exquisite regularity, viz., by inducing an atom of C into its empty pole, thus giving an icosahaedral combination COC, w = 100; which is the most solid combination of C and O; and which we may, therefore, expect to appear, and to remain when others have been destroyed. Thus, let the acid $C^{14}H^{4}O^{14}$ (meconic), mentioned last page, be submitted with care to more heat than it can bear, vapour and fixed air going off, while yet under the third law of Being, the remainder maintaining the dodecahedral type, there remains the new acid, $aqHO\,(COC)^{12}OHaq = 2(C^{12}H^{2}O^{8})$, (comenic acid).


COC

127. *Mould.*—It is not in combination with C, however, but as usual with CH, that we may expect CO to remain in nature, giving $COCH = C^{2}HO$, a formula, to which it has been perceived that the pyro-gallic and humic bodies, tend. And, indeed, if we construct its molecule, so as to protect the H from O, and thus to preserve it, while we mark the poles, as usual in subaerial species, by the atmospherical elements, we obtain the per centages of pure mould, thus

$$\mathrm{NCO}\left(\frac{\mathrm{COC}}{\mathrm{H}}\right)^{20}\mathrm{OCN}.$$

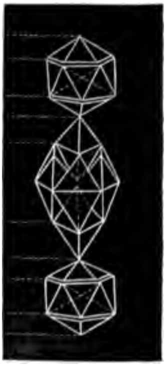
			Subeiran.	
C^{42}	1260	54.4	55.0	Humus from the heart of an aged oak not yet fallen to the ground.
H^{20}	100	4.3	4.8	
N	70	2.5	2.5	
O^{22}	880	38.2	37.7	


CHC = $C^{2}H$

128. *Anæsthetic.*—When the atom of O in styptic is replaced by one of H, so that instead of COC we have CHC, we obtain another combination possessed of great interest. It seems, in fact, to perform the same function in reference to the animal economy that COC does in reference to the vegetable, viz., to bring the most exquisite phenomena of vitality to a stand. Thus, over several degrees of latitude, where the climate is favourable to the development of the styptic principle COC, and the humic bodies prevail,

all the nobler phenomena of vegetation are prevented. Summer and winter scarce make any difference. All nature is thrown asleep in a bed of peat-moss. It is also known that the changeful phenomena of the higher life in animals, may be thrown into a state of sleep by certain agents, named narcotics or hypnotics, and, when administered by respiration, anæsthetics. Now, of such substances it appears that the poles or effective regions are constituted by the analogous combination CHC. Thus, ether (nobis) is composed of a body of single stimulant (86), with poles of this kind, viz., CHC,HaqH,CHC = C^4H^5O. Chloroform, again, is a dodecatom of chlorine with a double anæsthetic on each pole, evidently an agent of far greater power as an anæsthetic, as also more exclusively an anæsthetic, and safer, since, if it should undergo decomposition in respiration, all that need be apprehended would be the departure of only one anæsthetic from each pole, thereby leaving the poles of the chlorine still covered. Thus, CHC,CHC $(Cl)^{12}$CHC,CHC = 4 (C^2HCl^3) Sp. gr. = $\frac{4\,(60+5+540)}{1620}$ = 1·48 expt. 1·49.

129. *Vinegar.*—On referring to the two saccharine radicals, viz., HOC and HCO, the vernal and autumnal forms of the same combination, it is obvious that they must often meet; and when they do, they will ever tend to unite, giving the combination HOCOCH = ½ $(C^4H^4O^4$ or $C^4H^3O^3 + HO)$ w = 150, and therefore, in the aeriform state sp. gr. = $\frac{150}{72·1}$ = 2·08 Expt. 2·09. Such a body, inserted by its CH pole, which is more dissimilar to water than its OH pole, is altogether suitable for forming poles for a particle of AQ. The poles of the particle of water will thus be oxhydracid, the whole sour, and the acid part 5·8 per cent. Now, this is the normal per centage in true vinegar, showing that it is not a mechanical mixture but a chemical species, viz., HOCOCHaq (AQ) aqHCOCOH = $C^4H^4O^4$ + 38 aq. Also, HOCOCH $\left\{\begin{matrix} aq \\ am \end{matrix}\right\}$ HCOCOH; in reference to the former, of which an exquisite combination appears when one is inserted in every *aq* in a particle of AQ, giving as the element HOCOCHaqHCOCOHaq = $C^4H^3O^3$ + 3 HO, for which (allowing to so large a molecule as this 8 aqueous volumes), we obtain Sp. gr. = $\frac{36 \times 390}{1620} \div 8$ = 1·083 (Expt. 1·080). But there are many others, often polymorphous.



COCH*aq*HCOC = $C^4H^3O^3$ auct:

130. *Lactic Acid.*—When, instead of HOC, there is offered for union with HCO an atom of hydrostyptic COCH, there results a symmetrical product, viz., HCOCOCH (lactide), which must form a powerful polar element, for an atom of aq as a body = $C^6H^5O^5$. Inserting one in each aq of a particle of AQ, and allowing

four volumes to the molecule, we obtain 36 (HCOCOCHaq) = 18 ($C^6H^5O^5$ + HO) sp. gr. = $\frac{36\,(180+45)}{1620} \div 4 = 1{\cdot}22$ Expt. id.

131. *Formic Acid.*—Simpler than the saccharine radicals, which give by their union acetic acid, CO and HO when they meet must unite. In this case, there will result OCOH. But such acid elements in their turn meeting, will unite, giving OCOHOCOH. Of this combination, however, the axis is very long, while by the transformation into *aq* of the central H, along with one of the atoms of O adjacent, it becomes OCOCOH = C^2HO^3, from which we obtain a fine molecule, by inserting one in each element of *aq* in a particle of AQ = 36 (C^2HO^3 + HO). And for this molecule (allowing in consequence of its size four aqueous volumes), we obtain Sp. gr. = $\frac{36\,(60+5+120+45)}{1620} \div 4 = 1{\cdot}25$ expt. 1·235.

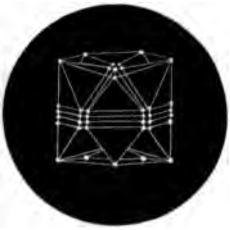
132. *Oxalic Acid.*—Similarly, formic or hydro-carbonic (OCOH), and carbonic (OCO) when they meet must unite, whence there will result OCOHOCO (subliming oxalic acid) = C^2O^3 + HO, which, condensing its axis by the transformation of the central HO into aq, gives OCOCO = C^2O^3, w = 180, a body analogous to OCO, fit for the poles of a large metallic species such as Ca. Moreover, instead of such a body as Ca, we might have one composed of the aqueous element merely, as for instance, we might have $\mathrm{OH}\frac{\mathrm{aq}^3}{\mathrm{aq}}\mathrm{HO}$, to which, giving the oxalic elements as polar forms we obtain $\mathrm{OCOCO,OH}\frac{\mathrm{aq}^3}{\mathrm{aq}}\mathrm{HO,OCOCO}$ = 2 (C^2O^3 + 3 HO). Not aq, however, but OCaO = 2 CaO auct: forms the most natural base or body for oxalic acid (see Calcium p. 77).

CHAPTER XII.

ALUMINIUM.

133. On inspecting the structure of carbonic acid under our laws, it appears that it must differ remarkably from silica as to its permanence in nature. When it exists in circumstances (such as the sunbeam), calculated to exalt the repulsion acting between the two atoms of O, which cover the central atom of C, the latter will be liable to be forsaken by them, or rather, given up to any body which is then soliciting union with it, while the atoms of O open and part on opposite sides of it. When, on the other hand, the existing force tends to give solidity and sphericity to the nucleus, OCO will break up into parts at other joints. The central atom of C will retain on each side

five of the metallogens which constitute the half atoms of O on both sides; while the other five on both sides, getting rid of their heteropolarity by union with each other, will reproduce either an atom of O by locking together, or a new metallic species (isamorphous with that which has now been obtained out of C and identical with **K**, p. 40), according as the conditions of existence are favourable to the development of the non-metallic or the metallic.



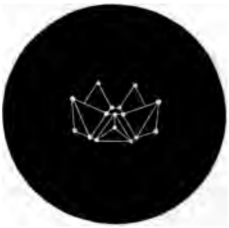
Al w = 70 = 14 H

Of these two metallic species, the former consists of an atom of C, all its faces bearing an atom of metallogen adhering. $W = 20 + 30 + 20 = 70$, equal to that of Si, but in other features differing remarkably from Si. Thus, in Si the equatorial parts are metallic, in this the polar are metallic. These two species will, therefore, under the general law of difference, tend to unite with each other. Moreover, let this species, which we may designate Al, be fully effloresced, so that the forces confined in the interior have gained the surface, and the species have become cellular, as all molecules in the lapse of ages tend to do, and it will be transformed into Si. In this old age of the world, therefore, we are not, perhaps, to expect OAlO in nature, but OSiO instead. If, however, Al should exist in such combination with O, that the axis of the combination is overlong already, and circumstances therefore favourable for the conservation of an oblate form such as Al, then, we may expect Al still in nature. Now, a sesqui-combination is of this kind. Though not OAlO, then, yet we may expect in nature $OAlOAlO = Al^2O^3$. Now such a combination gives 46·1 per cent. of O, and $w = 260$ ($= 52$ when $H = 1$ and 650 when $O = 100$), which agrees well enough with the Al^2O^3 of chemical works. The molecule of this species, as in others of the pentagonal series, will be dodecatom, $W = (12 \times 260) = 3120$, which, however, in the current of nature (as shown in reference to OSiO), will tend to become heteropolar as by the addition of an atom of Al to one of them; on which they will couple as shown before in reference to silica. Allowing to each such coupled element an aqueous volume, we obtain for alumina $\text{Sp. gr.} = \frac{(12 \times 260) + 70 + (12 \times 260)}{1620} = 3{\cdot}9$ (Expt. 3·93). The greater length of the element in the dodecatom being more powerfully urged by the law of sphericity, will here also produce greater condensation and hardness than in silica. A triatom will similarly give a rhomohedral system of crystallization, though of a different form.

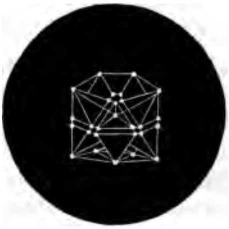
134. *Zircon?*—When the current in which a free atom of Al exists, is such as to lengthen and demand unity of axis, the pentifid poles will be gathered up into atoms of H, thus giving, between two atoms of H a beautiful species, isamorphous with carbon, but double the weight. The mineral zircon, which seems to be very extensively a granular element in metamorphic rocks, may be ZrOZr,OSiO,ZrOZr. This gives the per centages and sp. gr. Zr, $w = 60 = 2C = 3Bo$.

CHAPTER XIII.

POTASSIUM, SODIUM, CALCIUM.



$\frac{1}{2}$k, w = 20



k, w = 40 = 8H

135. *Potassium.*—It has been already seen that an atom of O, by lengthening its axis without changing the form of its poles, may open or unlock into two semi-metallics, one of which is here represented = 5A = 20. Now, towards the producing of such a change, any linear force along the axis, as also the law of sphericity generally, must tend; for O, when by itself, is one of the worst conditioned forms to which symmetry can be ascribed. But the same law which tends to unlock an atom of O into two such coronets will tend also to give to the resultant form salient instead of re-entrant poles. It will thus tend to invert the position of the two coronets into which the atom of O is drawn out, so that they apply to each other base to base, thus to form the beautiful metallic and cellular species k, w = 40. It may be said to be an atom of O turned inside out. It is also isamorphous with Al, and related to it as oxygen is to fixed air. We may therefore expect it to be of far more lively chemical agency, and more especially in its relations with oxygen, we may expect the greatest vivacity; for k is exactly the metallic counterpart of non-metallic O. The demand of O and k for union therefore must be extreme.

Being pentagonal, the molecule of k must be the dodecatom of which, as usual, a triatom may be supposed to form an integrant molecule or individual occupying one aqueous volume. In this case sp. gr. = $\frac{3\ (12 \times 40)}{1260}$ = .89 Expt. .86. Its lustre must be metallic, and from its relation to O it may well be expected to transform aq into HO, and uniting with the O to set the H when in the atmosphere on fire.

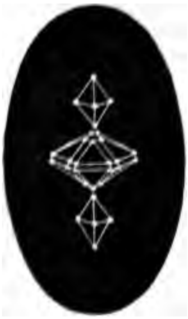
136. *Potassa.*—Its normal and mature or imago-combination with O must, as usual, be when a dodecatom has its poles oxygen, its body metal = O k^{10}O. But as a step towards the construction of this beautiful body, and when O is engaged in union with other substances, we may often expect an atom of the latter with 5k united around it; the five salient pairs of external facets in an atom of O being conformable to the five re-entrant couples in 5k; thus giving us $\frac{k^5}{O}$. In both, the

ratio of O to k is the same, and is that of the authorized systems adhering to the old equivalent of k, viz., 40H = 200 on our scale; K (the authorised equivalent) being obviously = 5k (nobis). And indeed, in order to be satisfied that the authorised equivalent of potassium is a group of atoms and not a single one, it is only necessary to inspect the polythionic series of potassium (remembering, however, also, that S auct: = 2S nobis.) Moreover, that the equivalents of bodies, as obtained in the laboratory after torturing experiments, in which much fire and violent chemical agents are forced upon delicately-constructed molecules such as k, should often come out too light, is only what our theory leads to expect. It is no wonder if, after deflagration, etc., K should be found more nearly 39H than 40H.

137. *Nitre.*—Now we may somewhat understand how the fine analagous yet counterpart molecule $N\,O^{10}N$ (see page 58) = 2 (NO^5 auct:) may be generated. Thus, the original nascent atmospherical element we have found to be NON. It is in want of equatorial matter, and k being given, in the proper circumstances we shall immediately have $N\frac{k^5}{O}N$. But k being the metallic counterpart of O, its presence here must immediately tend to give O^5 on the outstanding pole of the combination above, so that we obtain from both $\frac{O^5\ \ k^5}{N\ \ O}$ which going together in couples, each with another of its own kind, and then both together, give as symmetrical molecules $\frac{k^5}{O}N\,O^{10}N\frac{k^5}{O}$ and $\frac{O^5}{N}O\,k^{10}O\frac{O^5}{N}$, (and as an ultimate heteropolar molecule or molecule of aggregation in couples $O\,k^{10}O$, $N\,O^{10}N$). Being all of the pentagonal series of forms, they must as usual aggregate in dodecatoms or triatoms. Say the latter, as the combination is so large, and then allowing one aqueous volume to one such triatom we obtain

$$\text{Sp. gr.} = \frac{3\,(480 + 540)}{1620} = 1.9 \text{ (Expt. id.)}$$

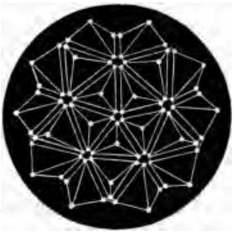
138. *Carbon again.*—It is very curious to observe, that if an atom of k be anyhow disengaged and subjected to a linear force tending to give unity to its axis, then the pentefid poles on both sides will, as in other cases, gather themselves up into atoms of H, and k is transformed into HCH. This, as has been shown, may constitute a gas in nature as CH^4C (p. 46). But if developed in a region where oxygen abounds, two particles of O coming on, one on each pole gives off from each pole an atom of HO = *aq*, and the carbonaceous body OCO = CO^2 remains. And thus, single atoms of potassium may secularly or organically be transformed in the presence of oxygen into vapour and carbonic acid. The latter again may be secularly transformed into k or O + Al. And of these the last into Si in the abyss of the ages.



HCH

SODIUM.

139. Potassa, when existing, as yet as $\frac{k^5}{O}$ is so oblate, that in regions of oxygenation it may be expected to receive an atom of O on each pole, giving $O\frac{k^5}{O}O = KO^3$ auct. But here the central atom of O exists in circumstances tending in an intense degree to invert it, that is, to change it from O into k. This done, we obtain an equatorial plate composed of one atom of k with 5k around it, the poles of the central k or both sides capped by O. This equatorial plate of k is nothing but a compressed dodecahedral molecule, which, let it but be inflated or expanded, is the most exquisite conceivable, possessing the same form but half the volume, and half the matter of a dodecatom of k. It is, however, no longer like it, decomposable into twelve elements, and therefore though to be expected to be analagous, yet not to be possessed of such diversified functions. Allowing half an aqueous volume to a triatom (or double to a dodecatom). Sp. gr.$=\frac{3\times240}{1620}\times2=.89$ Expt. .93. Its equivalent = 240 (= 48 when H = 1, and 600 when O = 100, or, estimated in reference to a single atom of O, 24 and 300). But its structure is so delicate, that after the torture of the laboratory, 23 is more likely to be found for its equivalent than 24. Its normal combination with O is obviously ONaO = 2 (NaO) auct: But here the metallic matter is still in excess over the non-metallic, and we may expect it not to part with HO if it has once caught an atom on each pole, and we shall have OH,ONaO,HO = 2(NaO + HO). $Na\frac{O^5}{O}Na = 2(NaO^3)$ can also be constructed. Nay, even an atom of carb. acid on each pole is not sufficient, viz., OCO,ONaO, OCO = $2(NaO,CO^2)$ though this is found. The true polar body for sodium is not oxygen, but the more powerful chlorine, as will appear hereafter.

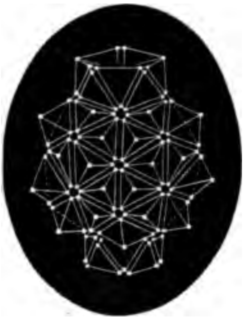


Na w 240 = 48 H
(= 2Na auct :)

CALCIUM.

140. *Lime.*—As we found Ph degenerating and attaining to repose as silicon, so it appears that sodium is similarly destined. Thus, instead of atoms of O resting on the poles, let atoms of hemioxygen or coronets (fig. ½ k p. 73), lock with them and we obtain a new species having oxygen poles like soda, and analogous, but yet in many respects different. The same will also be obtained, if, instead of setting out with $O\frac{K^5}{O}O$ as an oxide of potassa, we set out with OK^5O.

This, doubtless, nature produces in the laboratory of the vegetable world. But it cannot be permanent in nature; nor need we be surprised if it be not found. Its form is still very oblate, and the atoms of O are still very near each other, while by the repulsion operating between them as being similar, and the law of sphericity ever tending to develop every molecule into the spherical, nothing more is here required than that the atoms of O on the poles continue to retire along the axis, for the 5k to open into ten coronets in beautiful union with each other by their base edges, giving the most compact molecule we have ever met with, a regular dodecahedron in structure, the body metallic (sodaic), and the poles crystalline. The weight of the metallic part is 10 × 20 = 200 (which, when estimated in reference to one atom of O, and when H = 1 gives 20 and 250 when O = 100), and the polar oxygen is 80, which are the relative proportions of metal and oxygen in lime. The whole weight is 200 + 80 = 280, which shows the analogy of our atomic weights and those of the authorized systems, that of lime, according to them on the H scale being 28.0. The analogy of this species to the preceding is very obvious. And now, indeed, we may retrace a series of analogous forms :—



$OCaO,w = 40 + 200 + 40 = 280 = 56$ $H = 2$ (CaO) auct:

Potassa,	. . $O\ k^{10}O$	...	$OM^{100}O$	=	$2(KO)$.
Soda,	. . $O\frac{1}{2}k^{12}O$	...	$OM^{60}\ O$	=	$2(NaO)$.
Lime,	. . $O\frac{1}{2}k^{10}O$	...	$OM^{50}\ O$	=	$2(CaO)$.
Silica,	. . $O\ Si\ O$	...	$OM^{10}\ O$	=	SiO^2.
Carb. Acid,	. $O\ C\ O$	...	$OM^{0}\ O$	=	CO^2.

The column with M in it, shews the amount of metallic matter in each species, from which it appears that the three first have it in great excess, the last in total defect, while the fourth has it rather in defect than in excess. And hence, under a primary law of union (76. b.) the first three will tend to unite with the last two, and especially the last with the three first. Since all of these, then, are (nobis) recurrent species in the grand laboratory of nature, and cannot but meet sooner or later, instead of the four in separation, or forming molecules each by itself, we are to expect them in union—potassa, soda, and lime, with silica, and especially with CO^2 (anhydride carbonique).*

---

* A series of the same kind presents itself, when we revert from the pentagonal or mineral series of forms to the hexagonal or aqueous. Thus we have

$$\left.\begin{array}{llr} O,H\mathit{am}AQ\mathit{am}H,O & = & 2(NH^3)+38HO \\ O,H\mathit{aq}AQ\mathit{aq}\ H\ O & = & 40HO \\ O\quad H\ \mathit{am}\ H\quad O & = & NH^3+\ 2HO \\ O\quad H\ \mathit{aq}\ H\quad O & = & 3HO \end{array}\right\}\ \text{auct:}$$

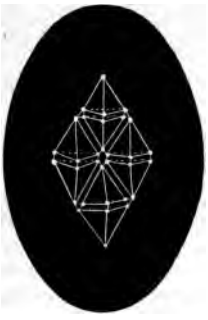
the upper very metallic in their structure compared with the lower, and such, that when the law of sphericity does not forbid, they will readily unite with each other, with OCO, etc. But the prosecution of such inquiries belongs to organic chemistry.

141. *Marble.*—If only HO were supplied to O $k^{10}O$, doubtless, it would be thankful for it, in as much as the atom of H is metallic. But what we are to expect in nature is $OCO\frac{k^5}{O}$, and as the imago or most perfect species, OCO,O $k^{10}O$,OCO, both = KO,CO^2 auct: The former, however, in order to symmetry and the capacity of existing in insulation, must adopt another atom of carbonic, giving $OCO\frac{k^5}{O}OCO = KO + 2CO^2$. This gives secularly OCO,OCaO,OCO = 2(CaO,CO^2) auct: w = 110 + 280 + 110 = 500. Constructing it as usual into dodecatoms, and these into triatoms, and to so large a molecule, allowing four aqueous volumes, we obtain sp. gr. = $\frac{3(12 \times 500)}{1620} \div 4 = 2.77$, Expt. id.

142. *Oxalate of Lime.*—When water, as well as oxygen and carbon, assist in the development, and, therefore, in the organic kingdom, often instead of OCO,OCaO,OCO = 2(CaO,CO^2), we obtain HO,OCOHOCO,OCaO,OCOHOCO,OH = 2(CaO,C^2O^3 + 2HO). Its poles being H, its molecule must be a tetratom or icosatom. Allowing $\frac{1}{4}$ of a volume to the single element, or one volume to the tetratom, sp. gr. = 2.07 (Expt. ?).

CHAPTER XIV.

SULPHUR, SELENIUM.

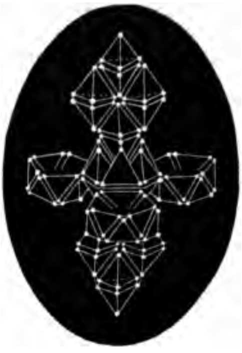


S

143. In the preceding pages we have seen O in want, and eager for H, as often as it can find it. But H is not always to be had where O often exists in vast abundance. Could not O then help itself to what it wants, by a change of its own form? What it now wants is an axis. It is intensely oblate; could not its constituent elements H arrange themselves so that the form resulting might have an axis, and both stand instead of H to O, and perform the functions of O in regions not suitable for the presence of O as such? To this it is to be answered that, let but the 5H which constitute an atom of O, instead of falling over upon each other, and uniting face to face, stand up so that their axes shall be parallel and their union be by an edge only, and thereupon we obtain a prolate form which is, in fact, an H on the great scale = S = $\frac{1}{2}$S auct: It belongs to the triangular series of forms like H, and its

poles are identical with those of H. But its weight is eight times as great, being that of oxygen, with which it is thus convertible, and of which it is the morphological counter-part among metalloids, as potassium is among metallics.

144. *Oil of Vitriol.*—The relation of S to O is analogous to that of H. As we have had HO, we may, therefore, similarly expect SO. But this is heteropolar, and not transformable into a homopolar form as HO is when it becomes *aq*. SO will, therefore, hurry into union, and supplying *aq*, just as before we had OH*aq*HO (see fig. p. 49), so now we may expect OS*aq*SO. But, in this combination, in consequence of the weight of S, the poles are obviously overcharged, while the equator is defective in matter. If, therefore, the two atoms of O on the poles, could apply themselves symmetrically to the equator, we might soon expect them to find their way there. The form of that equator, however, being hexagonal, the numbers required for symmetry are not 2, but 3 or 6. Let, then, another atom of O be supplied from the atmosphere, or some carrier of O, such as NO or ONO, and we may have, forthwith, the exquisite combination, $S\frac{O^3}{aq}S = SO^3 + HO$ auct: Manifold, besides, however, may the combinations of S and O be, though none so solid and noble as this.



$S\frac{O^3}{aq}S = SO^3 + HO$

As to the dense or liquid molecule of this acid, if fully constructed, it ought, of course, to be the icosatom (which we shall presently find to be that which solid sulphur ultimately affects), and if another atom of *aq* were supplied to each element, so that the whole molecule might be encased in a shell of water (vapour), there is reason to hope that lesser molecules, such as the tetratom, the hexatom and the octatom, might not diversify the liquid, and render the sp. gr. of difficult discovery. At all events, for this molecule = $SO^8 + 2HO$ auct: allowing two aqueous volumes to so large a molecule, we obtain, sp. gr. $= \frac{20(200 + 90)}{1620} \div 2 = 1.78$ Expt. id.

145. *Andhydrous Sulphuric Acid.*—S like H tends to form in tetratoms, and while we may have $SO^8S = SO^8$ auct: a grand molecule is possible, S being in tetratoms, viz., $S^4O^{12}S^4 = 4(SO^8)$ auct: Beautiful also is the polythronic series of S, both with O and K, which are analogous, as may be seen by any one who will take the trouble.

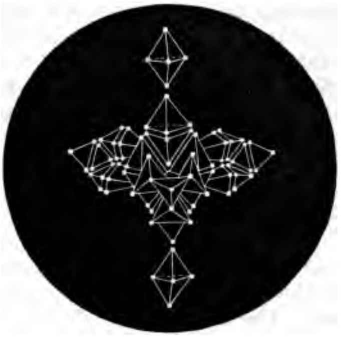
146. *Sulphur.*—Like other species of the triangular series of forms, the first molecule of this species must be the tetratom, of which there are no fewer than three forms; the most solid, that in which the three atoms on the equator insert their poles to the very centre (see fig. H S^4H abstracting the atoms of H, p. 79). And these, when most fully constructed into an integrant molecule, must constitute an

icosatom. Whence sp. gr. $= \frac{20(4\times40)}{1620} = 1.97$ Expt. 2.00. Interesting phenomena are to be expected when subjecting such molecules to heat. Thus, supposing a mass to be fused while yet these icosatoms (of tetratoms) are not broken up, we should expect it to be capable of the liquid state, for the molecules are eminently spherical. But when the heat is urged so that the icosatom is itself dissolved, and the heated mass consists of tetratoms merely, these being heteropolar, must try in various ways to cohere, and we may expect the mass to be viscous or cohesive. But, if the heat be urged further, so as to break up the tetratoms, then it is to be expected that the substance will resume its specific and original molecule, the icosatom—not as formerly composed of tetratoms, but of single atoms. And now, at this higher temperature, it ought to be as fluid as ever. And that sulphur displays such phenomena is well known.

147. *Sulphur Vapour.*—Supposing these icosatoms to be broken up, the heat being still farther urged, we may expect the species to be on the confines of the aeriform state. But, in order to enter upon this state, we may expect the tetratom, which is oblate, to take with it one atom more on each pole, giving S^6 analogous to H^6 (see p. 45). This hexatom, however, is not symmetrical, in consequence of the decline of the three atoms of S on the equator towards one pole, so that, to obtain a symmetrical combination fit for the aeriform state, these hexatoms may fly in couples. Allowing half a volume if the former, and a complete volume if the latter, we obtain sp. gr. $\frac{12\times40}{72} = 6.6$, which is that of sulphur vapour.*

148. *Hydrosulphuric Acid.*—The tetratom of sulphur may be prevented from returning to the molecular state, and also rendered buoyant and spherical, by attaching an atom of H on each pole, thus giving a species which reminds of CH^4C (page 46). Its composition is $H\ S^4H = HS^2H$ or 2(SH) auct: with which it must also obviously agree in sp. gr., allowing each H to retain its own volume.

149. *Sulphocyanogen.* — Of the same type is sulphocyanogen, the atoms of H on the poles being replaced each by NC ($= NC\ S^4CN = NC^2S^2 = CyS^2$ auct:)



$H\frac{S^3}{S}H = 2(HS)$ auct:

150. *Selenium.*—We have ascribed the genesis of S to the combination of 5H, so that they unite by an edge only, yet poles to equators, and so as to preserve unity of axis, a mode of combination which cannot but be very undecomposable. Let 5S combine in the same

---

* A finer dodecatom, however, appears in this species when in union with mercury, which may be also the aeriform molecule.

way, and there must result a chemical species highly analogous to sulphur, but five times as heavy, and perhaps equally undecomposable $w = 5 \times 40 = 200 = 40H$ (selenium $= 39.5H$).

CHAPTER XV.

ZINC, COPPER, IRON.

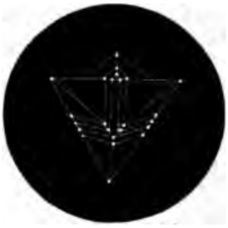
151. *Zinc.*—But the most interesting products of S, considered as a genetic principle, are those which result from the insidence of metallogens on its facets. Thus, let atoms of A (see fig., p. 33), fix on its six equatorial external facets, it must be thereby metallized, and its weight raised from 40 to 64. Moreover, the metallic elements thus generated, it might be shown, will aggregate around a cellular cavity, isamorphous with C, the symmetrical number in this the normal molecule being five of the metallized sulphurs; and this, it might be shown, satisfies the phenomena of the zinc of the chemist, Zn auct: being thus $= zn^5$ nobis (as $K = k^5$, etc.), Zn, $w = 5 \times 64 = 320 = 64$, when $H = 1$, and therefore, 32 when estimated for one atom of O.

152. *Copper.*—Let an atom of S receive metallogens, not on the six equatorial, but on the six polar facets, it now becomes of such a form that it can partition into two, both of which are symmetrical and identical with each other, by a section through the equator. And this partitionment is to be expected because the form when whole is prolate, while each of the halves is tessular. The specific metallic molecule, and ordinary equivalent in this case also, is a group of five elements, the weight the same as in Zn. And similarly, it might be shown that this species may represent copper; Cu, auct: being thus $= cu^5$ nobis. And so in many metals $W = w^5$.

IRON.

153. But sulphur, while, on the one hand, it must be subject to receive additions of metallogens, and thus give new species in this way, must also be subject to dissolution. The last part to be dissolved will be the nucleus of the icosatom and of the tetratom. And when these have got rid by efflorescence of the forces in their centres, twenty in the former case and four in the latter, these nuclei will remain as distinct metals, of which the latter (that derived from S^4) must possess quite novel properties, and may detain us still a moment longer.

The form is analogous to that of metallogen itself. It is heter-



$fe = \frac{1}{5}$ Fe auct:

opolar in a high degree. Its currents, therefore, will flow between the poles. It will be permanently magnetic. Hence, it cannot be raised into the aeriform state. It is also a tetratom of Ħ, the four ⊙ discharged from the centre. It may, therefore, have a meteoric as well as a mineral origin, and, in fact, may be expected everywhere. Its weight is $(4 \times 8) - 4 = 28$. Moreover, its form is such that a homopolar group of such elements must consist, like those just mentioned, of 5, $w = 140 = 28H$. It, therefore, agrees in equivalent with iron, and Fe, auct: $= fe^5$ nobis. But a finer molecule results from the union of ten single atoms of fe, $w = 280$. Two sorts of icosatoms are also attainable (the passive state) $w = 560$. Three atoms and four also form very solid molecules. Thus, this species has many equivalents, the lowest, viz., fe, itself no more than 5.6 on the H scale, the highest 112 on the same scale. Of symmetrical oxides, there immediately present themselves $\frac{fe^5}{O}$ and O $fe^{10}O$ (analogous to $\frac{K^5}{O}$ and O $K^{10}O$), oxygen in both 22.22 per cent., (and, therefore, the protoxide FeO of chemists), the weights = 180, and its double. Then a sesqui-oxide O fe^5O fe^5O (analogous to OAlOAlO, (fe^5 being just = 2Al), oxygen 30 per cent. This, when existing as a molecule in nature, may be expected to receive an atom of HO in the outstanding pole (Hæmatite), or an atom of fe instead, in which case it will be heteropolar or magnetic, and the oxygen reduced to 28.03 per cent. (magnetic iron ore). There may be other combinations with O, however. Thus (as we have seen in reference to phosphorus), fe^5O fe^5 may be formed, and receive an equator of O^5, giving $fe^5\frac{O^5}{O}fe^5 = 2(FeO^8)$ auct: etc.

154. *Nikel, Cobalt.*—Of the same type, there must also be several other species, of which one is the most elementary substance after H itself, viz., the form of fe, when reduced to the utmost, and composed of four metallogens surrounding a tetrahedral cell. Its volume will be half that of iron. The weight of the mass rather more. Also like iron magnetic, metallic, and incapable of the aeriform state. Such a substance, however, must be difficult of access to chemical agents, and till nickel and cobalt are better known, we may pass on.

CHAPTER XV.

MINERALOGY.

THE laws of symmetry and sphericity, which have been seen to rule in all that precedes and to determine it, rule also in the crystalline world, and render a science of mineralogy possible. Thus, taking the first four well-known silicates in Miller's mineralogy, and the all-important felspar, we obtain, as the element in each, a dodecatom, as usual, with the poles differently marked in each, but all symmetrically. Thus,

	Pole.	Body.	Pole.
Kyanite	$\ddot{\mathrm{S}}\mathrm{i}\,\dddot{\mathrm{A}}\mathrm{l}^2$	$(\ddot{\mathrm{S}}\mathrm{i}\ \dddot{\mathrm{A}}\mathrm{l}^2)^{12}$	$\dddot{\mathrm{A}}\mathrm{l}^2\,\ddot{\mathrm{S}}\mathrm{i}$
Andalusite	$\ddot{\mathrm{S}}\mathrm{i}$		$\ddot{\mathrm{S}}\mathrm{i}$
Staurolite	$\dddot{\mathrm{F}}\mathrm{e}^2$		$\dddot{\mathrm{F}}\mathrm{e}^2$
Tabular spar	$\ddot{\mathrm{S}}\mathrm{i}$	$(\ddot{\mathrm{S}}\mathrm{i}\ddot{\mathrm{C}}\mathrm{a}\ddot{\mathrm{S}}\mathrm{i})^{12}$	$\ddot{\mathrm{S}}\mathrm{i}$
Felspar	$\dddot{\mathrm{A}}\mathrm{l}^2\frac{\mathrm{K}^5}{\mathrm{O}}$	$(\ddot{\mathrm{S}}\mathrm{i})^{12}$	$\frac{\mathrm{K}}{\mathrm{O}}\dddot{\mathrm{A}}\mathrm{l}^2$

$$\text{KYANITE.—}\left.\begin{array}{l} (\dddot{\mathrm{A}}\mathrm{l}^2)^{14} = 3640 — 63{\cdot}4 — 63{\cdot}8 \\ (\ddot{\mathrm{S}}\mathrm{i})^{14} \ \ = 2100 — 36{\cdot}6 — 36{\cdot}4 \end{array}\right\}\ \text{Roraas.} \qquad \text{Arfwedson.}$$

$$\text{Sp. gr.} = 1620\,)\overline{5740}(\ 3.54\ \text{Expt.}\ 3.58 — 3.62.$$

$$\text{ANDALUSITE.—}\left.\begin{array}{l} (\dddot{\mathrm{A}}\mathrm{l}^2)^{12} — 3120 — 59{\cdot}7 — 58{\cdot}62 \\ (\ddot{\mathrm{S}}\mathrm{i})^{14} — 2100 — 40{\cdot}3 — 40{\cdot}17 \end{array}\right\}\ \text{Lisens.} \qquad \text{Bunsen.}$$

$$\text{Sp. gr.} = 1620\,)\overline{5220})\ 3.2\ \text{Expt.}\ 3.1 — 3.2.$$

STAUROLITE. Jacobson.

$$\left.\begin{array}{l} (\ddot{\mathrm{A}}\mathrm{l}^2)^{12} — 3120 — 54{\cdot}5 — 54{\cdot}72 \\ (\ddot{\mathrm{S}}\mathrm{i})^{12} \ \ — 1800 — 31{\cdot}5 — 29{\cdot}72 \\ 2\,\dddot{\mathrm{F}}\mathrm{e}^2 \ \ — \ \ 800 — 14{\cdot}0 — 15{\cdot}69 \end{array}\right\}\ \text{St Gotthardt.}$$

$$\text{Sp. gr.} = 1620\,)\overline{5720}(\ 3.53\ \text{Expt.}\ 3{\cdot}54 — 3.58$$

TABULAR SPAR. Bunce.

$$\left.\begin{array}{l} (\ddot{\mathrm{S}}\mathrm{i})^{26} — 3900 — 53{\cdot}7 — 53{\cdot}05 \\ (\ddot{\mathrm{C}}\mathrm{a})^{12} \ \ 3360 — 46{\cdot}3 — 45{\cdot}74 \end{array}\right\}\ \text{Greenville.}$$

$$+$$

$$1620\,)\overline{7260}(\ \div 2 = 2.24 +$$

FELSPAR. Berthier.

$$\left.\begin{array}{l} (\ddot{\mathrm{S}}\mathrm{i}^{12}) — 1800 — 64{\cdot}3 — 64{\cdot}20 \\ 2\,\ddot{\mathrm{A}}\mathrm{l} \ \ — \ \ 520 — 18{\cdot}6 — 18{\cdot}40 \\ 2.\frac{\mathrm{K}^5}{\mathrm{O}} — \ \ 480 — 17{\cdot}1 — 16{\cdot}95 \end{array}\right\}\ \text{Adularia from St Gotthardt.}$$

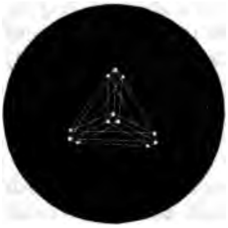
$$\text{Sp. gr.} = 1620\,)\overline{3\times2800}(\ \div 2 = 2{\cdot}59\ \text{Expt.}\ 2{\cdot}577.$$

From which we see, that the atomic volume is sometimes equal to that of water (Kyanite, Andalusite, Staurolite), sometimes double (Tabular Spar), sometimes that of the triatom double (Felspar), for the legitimacy of which, in connection with the dodecatom, see page 34.

CHAPTER XVI.

BARIC MOLECULES.

155. The preceding series of molecules have been constructed on the general idea that the first combination of ætherial forces which is in relation with space in all its three dimensions, viz., the tetratom w = 4 (see fig., page 33), itself not insulable, receives from the ambient æther, or some other source, a single additional ⊙, whereby it becomes homopolar and insulable, and is then the H of the chemist, w = 5. But in situations where insulation and the aeriform state is forbidden, and where disposable ætherial forces are abundant, as in the abyss, deep veins, and regions of subterraneous action generally, another result is to be looked for. In that case, we may expect that under the influence of the grand law of assimilation some one of the four angles of an atom of allogen (A, w = 4) will be assimilated to the region opposite, by receiving an accession of other 2⊙, three being then opposed to three around all the form, thus giving a new sort of allogen, the same in form, but each angle composed of 3⊙ instead of one, w = 12. Moreover, the same product may, in the same region, be expected more directly, viz., by the grouping into a tetratom, of ætherial forces already grouped in sets of three. Here, then, we have a new genetic radical inviting us to construct a series of forms similar to those which we have constructed already, and to go again to nature and the laboratory to see whether this new series will not be seen to represent other molecular agents which are encountered there. We may expect such of them as are isamorphous with those which we have treated of already to be so far analogous. But yet it is obvious that their action, in reference to the same substances, must be very different. Thus the elementary angular number here is 3⊙, which is also that of oxygen. Between oxygen, therefore, and the species now to be noticed (which we may call Baric species), there will be in general a repulsion (52) which does not exist among common or abaric species. And here, therefore, oxidation will not be the grand phenomenon, as it is in the other sphere. Some other bodies, which can insist upon their rights with greater force, and other numbers, may be looked for, as destined to perform among barics, the functions which oxygen does among abarics.



A, w = 12

156. In consequence of the crowding of forces also in the structure of baric species, their efflorescence, or expansion and development, may be expected to take place more easily and rapidly wherever there

are facilities, and thus each baric species to be devoloped into three of the analogous species of the abaric order, if nothing else is determined. Let us not look, therefore, for baric H, which is equal to 3H.

157. *Sea Salt.*—Let us leave the surface of the earth, and descend for a moment, as we have, indeed, twice done already, into the abyss. We now encounter the combination of BoO,N,OoB (page 59), of baric structure, w = 3 (20 + 40 + 80 + 40 + 20) = 600 = 120H. Suppose it to remain in the abyss, and a force to act from the centre of the combination efflorescing and expanding that centre until in that region it become cellular, we obtain as a central monometric body, first, a species isamorphous with phosphorus, but still baric, w = 240 (Arsenic *). And after that, when the molecule has become abaric, and is fitted for taking its place among abaric species, as, for instance, in the waters of the ocean, we obtain none other than the splendid molecule which we have already been led to regard as sodium (p. 75). On each pole of the atom of Na there is now, however, a baric combination, isamorphous with CO, w = 180 = 36 when H = 1, and 450 when O = 100. It is, therefore, to us plainly chlorine, which, as a non-metallic body, is obviously more fit for quenching the demand of so large a metallic body as Na than O is. Our formula for sea salt, therefore, is ClNaCl. Its molecule is, of course, the dodecatom, as with pentagonal forms generally.

158. *Brine.*—This dodecatom may be encased in a shell of AQ by an atom of HO as an intermedium on each of the twelve elements of the dodecatom of salt giving $(\mathrm{AQ}\textsc{ho}\mathrm{ClNaCl}) = 2(\mathrm{NaCl} + 18.5\ \mathrm{HO})$ = 26.5 per cent. of salt. An atom of salt with one of HO on each pole might nestle in a particle of *aq*AQ*aq* = 2 (NaCl + 20HO) giving 25 per cent. of salt. If the salt were wholly without HO, then the salt = 27 per cent., Expts. do. do.

159. *Sea Water.*—A particle of salt, when enclosed in a shell of fresh water, constitutes a particle of sea water, for which twelve particles of AQ for the body, and one for each pole, will be required, giving $\mathrm{AQ}\frac{\mathrm{12AQ}}{\mathrm{ClNaCl}}\mathrm{AQ}$. This element of the ocean gives 2.56 per cent. of chloride of sodium. Sp. gr. = $\frac{1620 + 19440 + 600 + 1620}{1620} \div 14 =$ 1.0264. Expt. = 1 0263, being the mean of eight experiments on board *La Bonite*, on the Sp. gr. of the waters of the tropical seas.

160. *Salt.*—Could salt be made to form a shell for a particle of water, as in nature water tends to form a shell for a particle of salt, so that each of the six meridians of AQ should carry a molecule of HO,ClNaCl,HO we obtain (HO,ClNaCl,OH)+6aq = 2(NaCl + 4HO). Of dry salt, Sp. gr. = $12(\frac{180 + 240 + 180}{1620}) \div 2 = 2.22$. Expt. id.

161. *Borax.*—And here a very interesting fact appears. Thus,

---

* The authorised equivalent of arsenic is three times the weight of this. The intimate structure of barics being composed in each element of three forces, the law of assimilation constantly tends to the development of triatoms in this order of bodies, hence the frequent occurrence of Cl^3, Pt^3, etc. (Platinum is baric iron, (nobis).

given a dodecatom of sea salt, it must have, of course, as a nucleus, a dodecatom of Cl. Now, Cl is the baric form of BoO or BO; and this, when developed into abaric without change of type, gives 3BO, so that the nucleus of $Cl^{12} = 3\ (BO)^{12}$ or $3\ (OB\,(BO)^{10}\,BO) = 3$ atoms of boracic acid.* Now, Bo($= Bo^{12}$ nobis:) exists in such relation to Na that its form and weight are the same, only it is the non-metallic form, of which Na is the metallic. We may, therefore, expect each to tend to develop the other, and a very stable combination to result from their union. And such is borate of soda when fully testudinated on the body with aqHO, and existing in triatoms.

$$\left.\begin{array}{l} 1.\ \text{atom acid}—680=35{\cdot}8—36{\cdot}5 \\ 1.\ \ —\ \ \text{soda}—320=16{\cdot}8—16{\cdot}4 \\ 20.\ \ —\ \ HO—900=47{\cdot}3—47{\cdot}1 \end{array}\right\}\ \text{Borax.}$$

Sp. gr. 1620)3 × $\overline{1900}$(÷ 2 = 1.76. Expt. 1.7—1.8.

CHLORINE.

The polar bodies on the atom of sodium in sea salt, must at first be heteropolar, and isamorphous with CO or rather ZrO. But, as the pole of Na to which they are attached is not convex but concave, it is to be inferred that by the time that the central icosatom has effloresced into Na, the polar bodies shall have symmetrized themselves, and have become homopolar; the atom in the pole isamorphous with C, but double the weight, (and which has been met with already, and conjectured to be Zr), having opened up into two atoms of C, one on each pole of a baric oxygen (which we may represent by broad-faced **O**). Cl thus becomes C**O**C, $w = 30 + 120 + 30 = 180$, analagous to COC (see fig., page 34) but little known to the chemist, because it cannot be insulated or raised into the aeriform state, as, however, Cl may. When developed fully into the abaric state without change of type, $Cl = 3(BO)$ *i.e.* a triatom of boracic acid $= BO^3$ auct: As an anticipation of which, the chloride of boron may be $= 3\ (BCl)$ occupying two volumes. Sp. gr. $3\ (\frac{20 + 180}{72.1}) \div 2 =$ 4.15. Expt. 4.035. Or it may be the dodecatom (Cl being substituted for O), and occupying 8 volumes.

162. *Hydrochloric Acid.*—And here, as we have had COCH the acetic element, so may we expect C**O**CH the hydrochloric element. It is not the acetic element, however, that is the equivalent of the hydrochloric. On this point a very interesting fact presents itself. Thus $C\mathbf{O}C = 30 + 120 + 30$. And if the central baric **O** become abaric after the same type, it must give $HOCOH = 5 + 40 + 30 + 40 + 5 = 120$. To this, then, add the baric C expanded after the same type, and we obtain HCOCOCH, that is, the lactic element

---

* According to this view the boric element is a form isamorphous with carbon, bosomed in one of oxygen, and half its weight; O = 66.66 per cent. in boracic acid when it is $(BoO)^{12}$. But O $(BoO)^{10}$O must be expected, raising O to 70.6 per cent. The intimate relation of this species to Si also appears.

(lactide), thus explaining so far the curious play of hydrochloric and of lactic acid in the stomach. But to return to muriatic acid. In consequence of its greater mass of non-metallic matter, this acid will demand more water to neutralize it, and it will hold a particle of AQ together with more force. As we had in regions of vegetable transformation HOCOCH*aq*AQ*aq*HCOCOH = a particle of water with acetic poles, so here, as a much more powerful agent in regions of animal transformation, such as the stomach, we may expect HOC**O**CH *aq* AQ *aq* HC**O**COH = a particle of water with hydrochloric poles $= 2(ClH + 20HO)$. By the concentration of the chemist, however, without destroying the form, the hydrochloric elements may be transferred from the poles of the particle of AQ to the meridians, in which case there may be, though at the utmost, six atoms of ClH, giving for this acid the ratio of $ClH + 6HO$. After that, there may be an atom of ClH on each alternate meridian, giving the ratio of $ClH + 12HO$. The specific form is, however, C**O**CH*aq*HC**O**C; and this, when carrying HO on the poles, may again occupy the poles of a particle of AQ, restoring the most symmetrical type. But, in this case, each acid element may be on the poles of a particle of AQ again, giving $64aq = 4\,(ClH + 16HO)$, and allowing two aqueous volumes to so large a molecule. Sp. gr. $\frac{(4 \times 185) + (4 \times 720)}{1620} \div 2 = 1{\cdot}11$. Expt. 1·10.

163. *Sal Ammoniac.*—The proper body for quenching or neutralizing ClH, however, is not *aq* but *am;* and this, accordingly, is what we meet with in nature.

164. *Bromine.*—But, though by efflorescence the polar body on the atom of sea salt may have partitioned its own polar element, so that instead of baric boron, or zirconium, it becomes 2C, yet its original form is heteropolar = **B**o**O** (similar to CO, carbonic oxide). Considering at once its agreement and its difference from C then, this body will tend to unite with C, and we may expect **B**o**O**,C,**O**o**B**, that is, the cell between two atoms of chlorine (which is just a mould for an atom of carbon), filled by an atom of carbon, giving a new species nearly allied to chlorine, $w = 180 + 30 + 180 = 390$ (= 78, when H = 1, and 975 when O = 100), and therefore agreeing with bromine.

165. *Iodine.*—To construct the most perfect molecule of carbon and chlorine, however, the central body must not be a single atom of carbon, but a group of ten C, which, together with its baric poles, must constitute a very fine species, to be expected very generally where decomposing sea salt and vegetable matter meet in circumstances favourable for the reconstruction of new molecules of a non-metallic character, $Cl\,(C)^{10}Cl$, $w = (180 + 300 + 180) = 660$. The extreme polar bodies may often, however, be atoms of C merely, and not the baric isamorph, in which case $w = 600$, mean 630 (= 126, when H = 1, and 1575 when O = 100), and therefore agreeing with iodine. (Mulders humic element is of the same type as iodine.)

166. *Fluorine.*—But all these species imply as their main bond of union, a baric species isamorphous with oxygen, viz., **O**, $w = 120$.

This baric oxygen, however, since abaric O is only insulable in coupled molecules (oxygen gas), and that in vessels of already oxydated material, we are not to expect to be insoluble, except in vessels whose walls are already testudinated with it, so that they may repel a form which is so powerful, and which in all other circumstances must be parasitic in the highest degree. Nor does it appear that it will be easily presentable to other bodies in single or even in coupled molecules at all. Thus we have found, generally, that a single atom of an abaric molecule, as for instance, an atom of Ca is the natural equivalent of two atoms of O, one on each pole of the central body, thus giving OCaO. In the case of so powerful a body as **O**, we are to expect to find more of the same base as its natural equivalent, as for instance, not OCaO, but **O**Ca**O**Ca**O** $= Ca^2\mathbf{O}^3$ (= CaFl auct :) Let us take a dodecatom of this sesquicombination, having its poles marked by the attachment of an atom on each, of the ordinary abaric type, viz. FCaF, and we obtain, using F for **O**,

$$FCaF\ (FCaFCaF)^{12}\ FCaF$$

$$\text{Sp. gr. } \frac{120 + 200 + 120(12 \times 760)120 + 200 + 120}{1620} \div 2 = 3{\cdot}08.$$

Expt. 3·02 – 3·18.

and 3F...... 360 .... 47·37
2Ca ... 400 .... 52·63
In the molecular state.
40F...... 4800 .... 48·53
26Ca .. 5200 .... 51·47
10000

See the best analyses of fluor spar.

In obtaining Fl, according to this view, from fluor, when replacing it by the sulphate, it will always be obtained in triatoms, $w = 3 \times 120$; whence we may expect the authorized equivalent of Fl to be one-half of $\frac{3F}{2} = 90 (= 18$, when $H = 1)$, which is as near the mark as need be cared for.

SULPHATE, CARBONATE.

167. The great interest of Fl lies in its becoming abaric by efflorescence into O^3, S^3, C^4, $HOCOH (= CO^2 + 2H)$, etc., whence, in the proper region as to heat and pressure, and the proper age of the world, instead of fluorides, we shall have sulphates and carbonates.

MAGNESIUM.

168. Of the various possible efflorescences of a metallic nature of which Fl is capable, a cellular species emulous of sodium, but only half the weight presents itself (2Fl being required to give Na). Of this species, which holds in nature the position of Mg, the weight when referred to one atom of O is $\frac{120}{2} = 60 = 12H$; and, therefore,

agreeing in equivalent with magnesium, whose oxide for us is of course OMgO like the others.

169. Thus, supposing an atom of Na exposed to violence, while it did its best to maintain its sphericity, cellularity, and metallic character, we should have at successive epochs of degeneration, first,

Na, then by the loss of 10 metallogens giving—
Ca, ... 20 others giving—
Mg, ... 10 others giving—
Ph, ... 10 others giving—
K, which is the smallest of the pentagonal type.

But Ph is subject to transformation into HSiH (p. 62), and K into HCH (p. 41), as also by inversion into O, which also gives S (p. 77); and, consequently, Fe (153), while K enclosing C, gives Al. And thus, by the successive partitionment of atoms of sodium in the abyss, we may have in the course of the ages, lime, magnesia, silica, alumina, potass, iron, carbonate, sulphate, quartz, felspar, water, etc.

Nor can sodium be dispensed with for the construction of the animal organization; to a few notes on which let us hasten.

CHAPTER XVII.

ORGANICS.

170. *Saccharine Saps.*—As AQ rises above the temperature of max. density, it becomes more and more oblate till it breaks into steam (95). But when oblate, the law of sphericity (45) proclaims it to be in want of more matter on the poles, and calls for more. Now this demand atoms of *aq* themselves can supply, and at successively rising temperatures, we shall have

$$\begin{array}{lcl}\mathrm{AQ} & \text{at say temp.} & = 40^\circ\ \text{Fahrt.}\\ aq\mathrm{AQ}aq & ,,\quad ,, & = 40^\circ + \\ \mathrm{OH}aq\mathrm{AQ}aq\mathrm{HO} & ,,\quad ,, & = 40^\circ + + \end{array}$$

Directing our attention to the last, it is truly a basic molecule of immense power, w = 1800. It may be regarded as a metallic oxide, and given access to carbonic acid, as, for instance, in the ambient air, water, or soil, we may expect the following series of changes:—

$$\begin{aligned} & 2\mathrm{OCO} + \mathrm{OH}aq\mathrm{AQ}aq\mathrm{HO} \\ &= \mathrm{OCO,OH}aq\mathrm{AQ}aq\mathrm{HO,OCO} \\ &= \mathrm{OC,O,H}aq\mathrm{AQ}aq\mathrm{H,O,CO} \\ &= \mathrm{OCH}aq\mathrm{AQ}aq\mathrm{HCO} + 2\mathrm{O} \end{aligned}$$

that is, the particle of basic water attaches an atom of carbonic acid to each pole. But when this has been done, two atoms of O come together, while by their presence an atom of C on each pole is kept separate from an atom of H, and the regeneration of CH (the original datum of nature) is thus prevented, and the first law of being resisted. It is, therefore, to be expected, that in the proper condition of existence, the two supernumerary atoms of O will go off as O into the atmosphere in exchange for the two atoms of OCO (carb. acid), absorbed, thus leaving on each pole of the particle of water an atom of HCO, giving a syrop of about 8 per cent. of saccharine matter, which, being reduced to the molecular state, will give sugar, of which there may obviously be many species, and even two genera both of the dodecatomic type, as also two of the icosatomic type, the poles specifically modified in the different species. (See figs. p. 67).

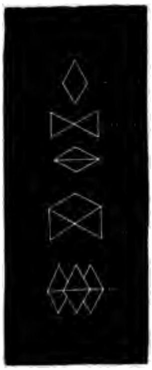
171. *Gelatinous Saps.*—But, where we have particles of water carrying OCH (p. 67) on their poles, we are also to expect particles carrying the more easily constructed converse form COH (p. 67). Now these are complementary (or positive and negative) to each other, and when they meet they will conjugate and give

$$\mathrm{OCH}\mathit{aq}\mathrm{AQ}\mathit{aq}\mathrm{HCO,COH}\mathit{aq}\mathrm{AQ}\mathit{aq}\mathrm{HOC},$$

that is, a molecule composed of two particles of saccharine sap rivetted together by HCOCOH, which, along with the saccharine matter, appears to be the pectic radical (see foot-note, page 68).

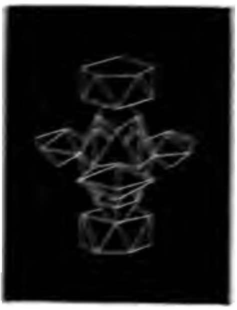
172. *Cellulose-producing Saps.*—Under the operation of the law of sphericity, however, such a combination must tend to shorten its axis and provide itself with a greater mass in the centre. And this it may do by aggregating the saccharine elements on the poles, into a molecule to form the central part. We thus obtain the very solid combination $\mathrm{AQ}\mathit{aq}\mathrm{HO,C}\left(\frac{\mathrm{HC}}{\mathrm{O}}\right)^{10}\mathrm{C,OH}\mathit{aq}\mathrm{AQ}$. Such a body, however, cannot but be greedy of carbonic acid as we have seen AQ to be already. Here, however, carb. acid cannot occupy the poles as it did before. The two particles of AQ will, indeed, attract it, but now they must dispose of it around the equator of each of those atoms of *aq* by which the terminal particles of AQ are united to the central molecule of sugar. Now, the smallest number of atoms of OCO compatible with symmetry on the equator of *aq* is 3, which number the hexagonal form of AQ must also tend to construct. But, these atoms of OCO in the proper conditions of existence will open, and the oxygen in each becoming aeriform, and going into the atmosphere, to replace the carbonic acid absorbed, there will result the beautiful strueture

$$\mathrm{AQ}\frac{\mathrm{C}^8}{\mathit{aq}}\mathrm{HOC}\left(\frac{\mathrm{HC}}{\mathrm{O}}\right)^{10}\mathrm{COH}\frac{\mathrm{C}^3}{\mathit{aq}}\mathrm{AQ} = 4500 = 100\mathit{aq}.^{1}$$



[1] From the combination at which we thus immediately arrive in this field, it will at once be seen that to attempt to represent molecules even by their leading lines of force, would involve great labour and expense. Let us, therefore, adopt, in what remains, sectional diagrams and that of the four great organic elements, only, postponing others. Thus, a lozenge may represent a section or profile of H. The same form bisected, and the two summits united in the centre, may represent a section of O. The lozenge with a line drawn through it as a longer diagonal, may represent a section or profile of C; and two lozenges united by an edge which is not drawn, while the shorter diagonals are drawn, may represent N, showing its heteropolarity and the necessity of coupling into Ɲ in order to symmetry. Three lozenges with their axes parallel, as represented, may stand for *aq*, and a couple on the same axis for *am*. With these sectional diagrams, it is wonderful to what an extent organic molecules may be represented.

But here we see a new species of a higher organisation than any we have yet met with, and remarkable also for this, that C is now in combination with H on its equator, and not on its pole, as in former cases. Supposing this new species separated and protected monopolar by attaching to the defective pole an atom of HO, we obtain this exquisite combination $OH\overset{C^3}{\underset{aq}{-}}HO$, and what is this? Assuming it in the meantime to be elementary cellulose, our beautiful sap element last obtained consists of water, cellulose, and cane sugar in the following proportions:—

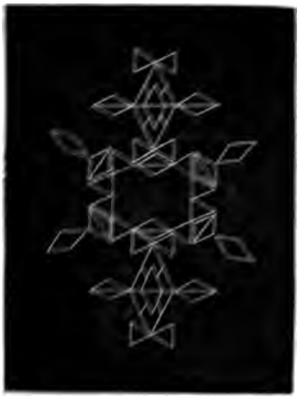


$OH\overset{C^3}{\underset{aq}{-}}HO = C^3 - 2HO$

						Peligot.	
1. Cane Sugar,	...	216	...	13	...	13.9	}
2. Cellulose,	...	450	...	15	...	9.9	Otaheite cane sap.
2. Water,	...	3240	...	72	...	72.1	}

172. *Starch.*—When the particles of AQ on the poles of the grand sap element have been dissipated or spent, there remain two particles of elementary cellulose, one on each pole, of a particle of sugar as a nucleus. If it immediately gain the molecular state it will be merely testudinated externally by O (belonging to OH), and thereby protected from eremacausis. But if it exist in single elements it will soon carry HO on each pole, as in the accompanying diagram. Its successive formulæ will therefore be

$$\left.\begin{matrix} C^{18}H^{14}O^{14} \\ C^{18}H^{15}O^{15} \\ C^{18}H^{16}O^{16} \end{matrix}\right\} \text{giving } C = \left\{\begin{matrix} 46.2 \\ 44.2 \\ 42.9 \end{matrix}\right\} \begin{matrix} \text{per cent.} \\ \text{the rest} \\ \text{HO or} \\ aq. \end{matrix}$$

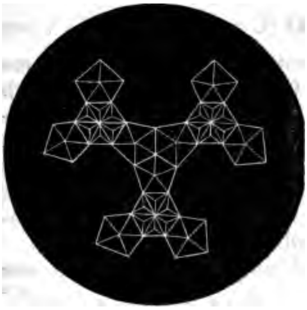


$OH\overset{C^3}{\underset{aq}{-}}HO, C\binom{C,H}{O}C, OH\overset{C^3}{\underset{aq}{-}}HO$
$C^{18}H^{16}O^{16}$.

According to this view, starch is a store of cellulose and sugar, the latter kept up by the former from solution and the action of the atmosphere, for future use. When the cellulose is called into requisition (germination, etc.), the sugar will become naked, etc. And it might be shown that, by such a molecule, the possible modifications of starch could be explained. As to its equivalent (being one-third higher than that commonly taken), it gives PbO^3 instead of PbO^2 for its lead oxide combination, which will be admitted to be better and more usual.

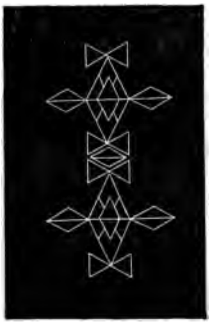
174. *The Elementary or Aerial Cell or Spore-balloon.*—The beautiful combination of which $\overset{C^3}{\underset{aq}{\cdot}}$ is the radical is such, that elements of this kind, when they meet, must unite by their equators, and that in the first instance in sets of three, giving a group of which a diagram on

the plane of the equator is here represented. Cellulose not being a chemical, the laboratory ~~possesses~~ no means of determining the number of atoms of C which enter into the composition of an element. The choice of C^{12} is quite arbitrary and very unhappy. The genius of C. Schmidt, however, has leduced C^9 in a way which is equally ingenious and legitimate (see his views of Chitin).



$\left(OH\underset{aq}{\overset{C^3}{-}}HO \right)^3 = C^9 H^9 O^9.$

Such trinal groups are curved, and, when they meet, they are eminently suitable for uniting into cells composed of at least twenty such, and which may be much larger, as, for instance, consisting of thirty-six or thirty-eight. Now, a cell composed of such, when each of the atoms of *aq* has received one of HO in its pole, will be secure from oxygenating agents generally, and very permanent in nature, if excessive heat be not applied. Considering, however, that, except the carbon, such a cell consists entirely of elements which tend to the aeriform state, it seems probable that, when developed completely, and when free, it will mount into the air. Being testudinated by oxygen, however, it will be very parasitic (89), and tend to attach itself to carbonaceous bodies generally, as, for instance, to sporules, etc. Thus, such cells will effect the diffusion of spores, and explain the recent discoveries of telescopes, etc., the development of fungi, etc., wherever there is a pabulum.



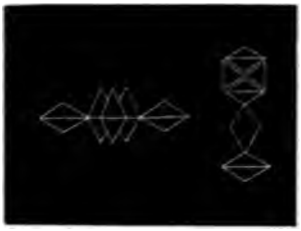
$H\underset{aq}{\overset{C^3}{-}}HOCOH\underset{aq}{\overset{C^3}{-}}HO = C^7H^6O^6.$

175. *Phyto-cellulose.*—As soon as an additional atom of C is supplied to an element of aerial cellulose, so that instead of $OH\underset{aq}{\overset{C^3}{-}}HO$ it is $COH\underset{aq}{\overset{C^3}{-}}HO$, these two will unite as we have already so often seen in reference to inorganics. We thus obtain $OH\underset{aq}{\overset{C^3}{-}}HOCOH\underset{aq}{\overset{C^3}{-}}HO = C^7H^6O^6$, which we may expect to be both fixed and palpable, and the most vernal or least carbonaceous state of cellulose. It is also very fit for the construction of cells, which, compared with the aerial sort, will have double walls and be strong.

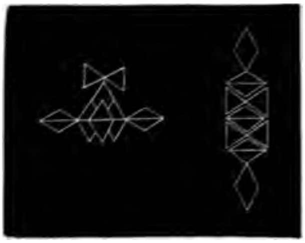
$$OH\underset{aq}{\overset{C^3}{-}}HOCOH\underset{aq}{\overset{C^3}{-}}HO = \left\{\begin{array}{lrrrr} & & & & \text{Payen.} \\ C^7 & 210 & 43{\cdot}75 & 43{\cdot}6 & 43{\cdot}4 \\ H^6 & 30 & 6{\cdot}25 & 6{\cdot}1 & 6{\cdot}0 \\ O^6 & 240 & 50{\cdot}00 & 50.3 & 50{\cdot}6 \end{array}\right\} \begin{array}{l}\text{Cellulose}\\ \text{from ovules}\\ \text{of almonds,}\\ \text{pith, etc.}\end{array}$$

When fully charged with C, it can receive one atom more in each pole, raising this element to $C^9 = 54{\cdot}0$ per cent. as found in oak, beech, etc.

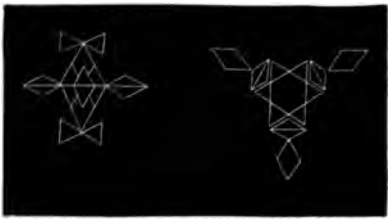
176. *The Degenerations of Cellulose.*—The simple cellulose radical $\frac{C^3}{aq} = C^3 H O$ (C = 66·6 per cent.), when all its elements are strung on the same axis, gives COCHC, a radical of much importance, appearing in many interesting substances, such as hippuric acid, and tannic acid, if we are to go by the old and long-approved formula for the latter, which also explains best its relations to gallic acid.


Hippuric.

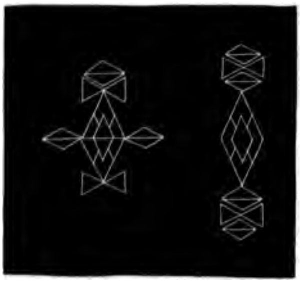
The next stage, when there is added an atom of HO in one pole (C = 50 per cent.), gives for $OH\frac{C^3}{aq}$ when disposed on one axis HCOCOCH (lactide), which is the polar element in lactic acid, a chemical whose functions are proved every day to be more and more important, being in the animal economy what acetic acid is in the vegetable, bad neighbours both of them, and such as degenerating organic elements are ever apt to fall into.


Lactic.

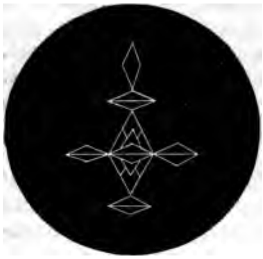
The next stage, when there is added an atom of HO in the other pole, so as to make the combination symmetrical (and C = 40 per cent.), gives a saccharine triatom $(HCO)^3$; and, therefore, cell-elements of this structure, when forced into the axial form, will give sugar, four triatoms or a tetratom of triatoms giving the dodecatom $C^{12}H^{12}O^{12}$, the most familiar sugars.


Saccharine.

The next stage is when one of the poles of the preceding is filled by an atom of C, giving $COH\frac{C^3}{aq}HO = C^4 H^3 O^3$: that is (C = 47·1 per cent.) And here we have an element of anhydrous acetic acid, which is, however, of course, a difficultly producible substance; because the original product of nature being HOC, we are usually to expect HO on one pole, more than the above formula gives, and therefore $COCHaqHCOC,OH = C^4 H^3 O^3 + HO$ as usually found in the laboratory.

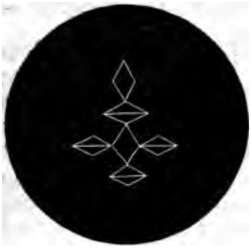

Acetic.

When both poles are supplied with an atom of C (C = 52·7 per cent.), we obtain a species of great stability, which may be expected to play an important part in nature. In the course of maturition, however, it must gain H and lose O, giving first $\mathrm{COH}\overset{C^3}{\underset{aq}{-}}\mathrm{HOC} = C^5H^8O^3$, after that $\mathrm{HCOH}\overset{C^3}{\underset{aq}{-}}\mathrm{HOCH} = C^5 H^5 O^3$, and ultimately $\mathrm{HCH}\overset{C^3}{\underset{aq}{-}}\mathrm{HCH} = C^5 H^5 O$. These, and their multiples, therefore, such as $C^{10} H^{10} O^2$, are to be expected in the laboratory. In nature, however, for the purpose of constructing large molecules, we must fix on some heteropolar, and therefore active state, as for instance, that represented, viz., $C^5 H^4 O$.*



Resinoid.

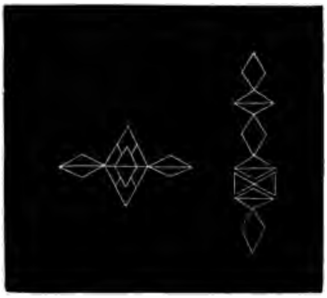
When reduction has taken place to the utmost, but without loss of H, we obtain the ratio of $C^5 H^4$, eminently polymorphous (the nonoxygenated essential oils), while, by the loss of 2H the type is restored; with this difference, however, that the body is now H merely, instead of HaqH. A couple forming a symmetrical combination, may distil over $= C^{10} H^4$, and a tetratom $= C^{20} H^8$, of it may give solids, etc.



Naphalinic.

But there is no end to possible hydrocarbons.

Let us only remark, further, that the element of aerial phyto-cellulose (fig. 1 page 91), must often be subject to the loss of its atoms of O on the poles. As for instance, in the state $\mathrm{COH}\overset{C^3}{\underset{aq}{-}}\mathrm{HO} = C^4 H^3 O^3$ (see the fig. opposite marked "Acetic"), the CO on one pole must often unite with the atom of O on the other, giving $OCO = CO^2$, which will go off in the aeriform state, leaving $\mathrm{H}\overset{C^3}{\underset{aq}{-}}\mathrm{H} = C^3 H^3 O$ (the formula of acetone), polymorphous, when its constituents are disposed on the same axis, and presenting,



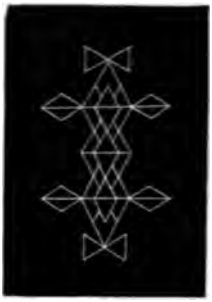
Acetonic.

---

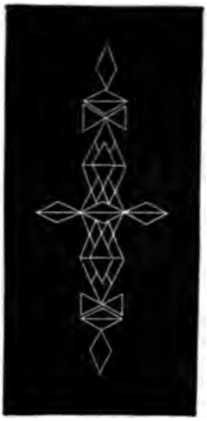
* These elements, when they form into molecules round the H pole, must give icosatoms, to which, adding animalized or ammoniaco-saccharine poles, such as $OCHNHNHCO = C^2 H^3 NO^2$, or without O as in Hippuric acid, we obtain Schreckers formula for cholic and hyocholic acids, thus:—

$$OCHNHNHCO(C^5H^4O)^{20}OCHNHNHCO = 2(C^{52}H^{43}NO^{10}).$$

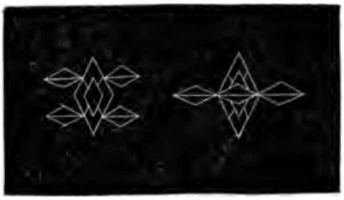
when taken in succession, parts of the most important vegetable organic residuary elements.



177. *Hypertrophy of Cellulose.*—The central body in the element of phyto-cellulose conceived and figured (page 91) is nothing more fixed than an atom of carb. acid. In certain conditions of existence, doubtless, it will go off, and its place be taken by an atom of *aq*, giving $\mathrm{OH}\underset{aq}{\overset{C^3}{-}}\mathrm{HaqH}\underset{aq}{\overset{C^3}{-}}\mathrm{HO}$, which also may be generated at once, $= C^6\ H^7\ O^5$ (nascent mannite). But now the equator having six regions of union, and, therefore, being fit for the accommodation of all the carbon present, we may expect the central body to become $\underset{aq}{\overset{C^6}{-}}$. And, adding the constantly recurring and mature combination CH to each pole, we obtain $\mathrm{HCOHaqH}\underset{aq}{\overset{C^6}{-}}\mathrm{HaqHOCH} = C^8\ H^9\ O^5$, obviously consisting of $C^8\ H^7\ O^3 + 2aq$, and such, that it may supply many of the chemicals of the laboratory. But in the whole of this region of nature, the symmetrical forms which are possible to every formula, are so various, that it requires special study and long argument to identify molecular theoretical constructions, with the various substances met with in the actual world. Yet there is not a more pleasing inquiry under our theory, than that into the viscous and Butyric fermentations, the former attaching to the vegetable, the latter to the animal, economy, as do those substances generally, into whose formula C^8 enters, which, strange to say, has excited but little the attention of chemists.

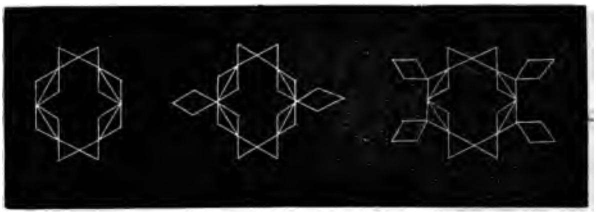


The radical part of this type now is $\mathrm{OH}\underset{aq}{\overset{C^6}{-}}\mathrm{HO} = C^6\ H^3\ O^3$, and $\mathrm{H}\underset{aq}{\overset{C^6}{-}}\mathrm{H} = C^6\ H^3\ O$, which play a very important part in nature and in medicines, and which, in the various metamorphoses they are capable of, may well cause all the bewilderment the chemist finds in the regions of phenyle, quinone, benzoyle, salicyle, etc. Viewed as coupled, in which case its form suits the law of sphericity, we obtain from the latter $C^{12}\ H^6\ O^2$, and by adding an atom of C to each pole, $C^{14}\ H^6\ O^2$.



$\frac{C^4}{H}aq\frac{C^3}{H}$ $C^6\ H^3\ O$ $\mathrm{H}\underset{aq}{\overset{C^6}{-}}\mathrm{H}$

But both are capable of dodecatoms, which must be eminently stable when the body is, as it may be, $O\,(C)^{10}O$, which, with regard



$$O\,C^{10}O = C^{10}O^2 \qquad O\frac{H^5}{C^{10}}O = C^{10}H^5O^2 \qquad O\left(\frac{H}{C}\right)^{10}O = C^{10}H^{10}O^2$$

to its equatorial region, may carry either 5H or 10H upon it, and thus supply radicals for a host of natural and chemical products, as the poles are varied.

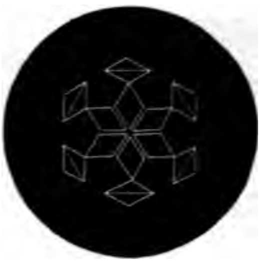
Benzoics.—It is to be remembered, however, that the first isometrical combinations of $H\frac{C^6}{aq}H$ is the tetratom $=\left(H\frac{C^6}{aq}H\right)^4 = C^{24}\,H^{12}\,O^4$; and this also may at once give a fine dodecatom, of which we may be almost sure when the element is heteropolar through the addition of another atom of C to each of the four elements, giving $C^{28}\,H^{12}\,O^4 = 2(C^{14}\,H^6\,O^2)$. Supposing it to exist thus, it would immediately demand 2O from the air, and we might have the poles consolidated, and each carrying an atom of $HO = 2(C^{14}\,H^5\,O^3 + HO)$.

178. *Tannics.—Hippurics.*—Add an atom of CO to each of the ten elements of the body, so that each of these elements shall carry COCH (Humic, Pyrogallic), instead of CH merely, and modifying the poles according to the regions and conditions of genesis, we obtain with $(CO)^3$ for the polar addition $(CO)^3O\left(\frac{COC}{HC}\right)^{10}O(CO)^3 = 2(C^{18}\,H^5\,O^9)$; (Tannic acid), and with $(CH)^3$ as the polar addition (N replacing O in the line of the axis), we obtain $(CH)^3\,N\left(\frac{COC}{HC}\right)^{10}N(CH)^3 = 2(C^{18}H^8NO^5)$ (Hippuric acid). Stripping off from the former COCH from the body, and adjusting simultaneously the poles, there remains $HO,COC,O\,(C)^{10}O,COC,OH = 2(C^7HO^3)$ (Gallic acid).

179. *Caproics, etc.*—The radical $O\left(\frac{H}{C}\right)^{10}O$ supplies, according to the structure of the poles, the ultimate form of a great variety of nearly-related species: thus, with

	Pole.	Body.	Pole.		
Poles	hydrogen,............ H	$O\left(\frac{H}{C}\right)^{10}O$	H	$C^{10}\,H^{12}\,O^2$	
	oxygen, ... O		O	$C^{10}\,H^{10}\,O^4$	
	carb. acid, ... OCO		OCO	$C^{12}\,H^{10}\,O^6$	$= 2(C^6\,H^5\,O^3)$
	saccharine,...... COH		HOC	$C^{12}\,H^{12}\,O^4$	Caproic.
	lactic, ... HCOCOCH		HCOCOCH	$C^{16}\,H^{14}\,O^6$	$= 2(C^8\,H^7\,O^3)$
	acetonic, ... $H\frac{C^3}{aq}H$		$H\frac{C^3}{aq}H$	$C^{16}\,H^{16}\,O^4$	

180. *Caprics, etc.*—But as soon as the atoms of H amount to twenty in the molecule, the type will change so as to give the H centrad, which, with O poles, gives $O\left(\frac{C}{H}\right)^{20}O = C^{20}\,H^{20}\,O^{4}$. And thus, by the morphological relations of the forms of the pentagonal series, ever culminating towards dodecatomic molecules, and those of the trigonal series ever culminating towards icosatomic molecules, a beautiful play is kept up in nature, and substances are produced in couples, or rather we ought, perhaps, to say in pairs, which are beautifully analogous, and yet not to be identified.



$\left(\frac{C}{H}\right)^{20} = C^{20}\,H^{20}$

181. *Palmitics, Cetylics, etc.*—Then, by the union of one of the dodecatomic with one of the icosatomic type, the poles various, as for instance saccharine, we obtain such a formula as

$$HCO\left(\frac{C}{H}\right)^{20}O\left(\frac{H}{C}\right)^{10}OCH = C^{32}\,H^{32}\,O^{4}$$

182. *Stearics, Margarics, etc.*—After this, we may have both the dodecatoms and the icosatoms in triatoms, but each by itself, giving as the radical numbers $C^{36}\,H^{36}$, and $C^{60}\,H^{60}$ to be added to according to the poles, which, moreover, must also give oxygen.

183. *Laurics, etc.*—The series of dodecatoms may also begin with $(CH)^{2}$, instead of merely CH as the element, giving double oils, as for instance, with aldehydic poles,

$$HCOCHO\left(\frac{HC}{HC}\right)^{10}OHCOCH = C^{24}\,H^{24}\,O^{4}.$$

184. *Oleics, etc.*—Similarly the element of the dodecatom may be $(CH)^{3}$, giving triple oils; as for instance, with lactic poles,

$$HCOCOCH\begin{pmatrix} CH \\ \hline CH \\ \hline CH \end{pmatrix}^{10}HCOCOCH = C^{36}\,H^{34}\,O^{4}.$$

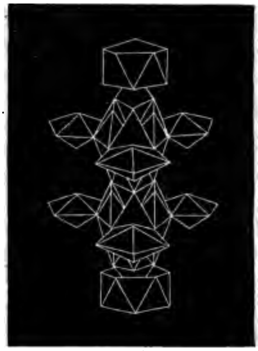
And thus (though not, perhaps, by building on these very constructions which are done chiefly for illustration), the whole series of well known fatty substances may be developed and accounted for, and ultimating those of a higher order, such as

185. *Cerebrics, Oleophosphorics, etc.*—The fatty part of which leads to the conception of a margaric body, with a triatom of carb. acid as the polar body: thus,

$$(OCO)^{3}\begin{pmatrix} CH \\ \hline CH \\ \hline CH \end{pmatrix}^{20}(OCO)^{3}$$

agrees perfectly with the percentages in Fremy's analysis of cerebric acid, the H unaccounted for being combined with N and Ph.

185. *The Culmination of Phyto-cellulose into Zoo-cellulose.*—The most rudimentary state of phyto-cellulose we have found to be $\mathrm{OH}\overset{C^3}{\underset{aq}{-}}$ (see fig. 2, p. 92), the first appearance of vegetation in vernal saps. Now, though its simplest movement is to complete its form, by drawing into its defective pole an atom of HO, so as to give to nature $\mathrm{OH}\overset{C^3}{\underset{aq}{-}}\mathrm{HO}$ (see fig. 1, p. 90), *i.e.*, an element of aerial-cellulose, yet it is to be expected that these bodies, when in the rudimentary state, will conjugate by their aqueous regions, so as to give $\mathrm{OH}\overset{C^3C^3}{\underset{aqaq}{\longrightarrow}}\mathrm{HO}$. But this according to our views (97), will ultimately be $\mathrm{OH}\overset{C^3C^3}{\underset{am}{\longrightarrow}}\mathrm{HO}$, while we shall also have the same beautiful structure from *am* itself and at once, so far as *am* was introduced into the vegetable structure from without. We thus obtain an element of cells of a higher order, the axis being *am* instead of *aq*. Under analysis, it must give



$\mathrm{OH}\overset{C^3C^3}{\underset{am}{\longrightarrow}}\mathrm{HO} = C^6H^5NO^2$

			Dumas.	
C^6 ...	180 ...	50·7 ...	50·73	See the analyses of Legumine and those nitrogenous products of organisation generally in which, N is a maximum in reference to C.
H^5 ...	25 ...	7·0 ...	6·95	
N ...	70 ...	19·7 ...	18·76	
O^2 ...	80 ...	22·5 ...	23·56	
	355			

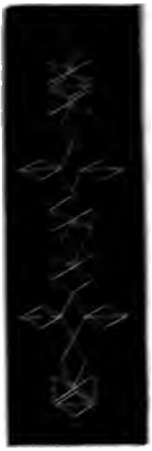
But under the successive reductions to C and the process of maturition, both the poles will be filled with atoms of C; and on one at least, there must be an atom of HO, by which this organic element may be united to a particle of AQ, which is the accompaniment of all organisation. We thus obtain $\mathrm{COH}\overset{C3C3}{\underset{am}{\longrightarrow}}\mathrm{HOC,OH} = C^8H^6NO^3$.

			Mulder.	
C^8 ...	240 ...	52·2 ...	52·7	See the analyses of fibrine, etc. The formula here given has been exactly determined by C. Schmidt, as the composition of the element of the muscles of insects.
H^6 ...	30 ...	6·5 ...	6·9	
N ...	70 ...	15·2 ...	15·4	
O^3 ...	120 ...	26·1 ...		
	460			

The accompanying water in the organism must be to the organic matter as AQaq (=1665) : 460 = 78·4 : 21·6, which is exactly the quantity of water found in flesh, etc.

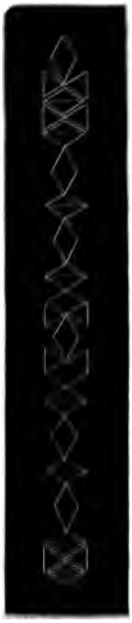
186. *The Dimorphism* (implying the contractility) *of the Tissue Element.*—By reference to p. 55, it will be seen that the axial part of

the combination now considered, is capable of two forms, between



which it may reciprocate according to the conditions of its existence, viz., Am and HNHNH. Similarly, the same element may be constructed with either an Am body as on last page, or an HNHNH body, as in the margin, the most carbonaceous state being represented, and HO included. Here we have the same elements, and here, also, they are very symmetrically disposed. The entire form and structure is now, however, more of the pentagonal order, the order of carbon, than it was before; and this, therefore, we may regard as the mature or autumnal form of this element, that in which it is presented by nature in seeds, and most generally delivered to the stomach or the cook. Under the predominance of aqueous forms, however (by cooking or digestion), it may obviously be restored to the vernal or Am form. And between these it may, according to the condition of existence, alternate, the axis, meantime, lengthening or shortening according as it exists under the pentagonal or the hexagonal type of structure. In this way, a fibre or tissue, which shall be vitally extensive and contractile, may be easily conceived.

187. *The Degeneration of Tissue.*—But to such reciprocations there must be a limit. After a certain amount of work has been done, the apparatus can be no longer fit for more. Every consciousness of effort in man, and every effort in the lower animals, indicates the destruction of the organic equilibrium on the side of life. The tendency towards the spherical (which is the physical law), will be over-balanced by the thrust towards the linear (which is the vital law). Ultimately, therefore, the organic autumnal form will be transformed, so that all the atoms of C shall be strung in a linear series, on the same axis, as in the diagram on the margin. But this once done, a return to the organic type, whether of the pentagonal or hexagonal series of forms, is no longer probable.

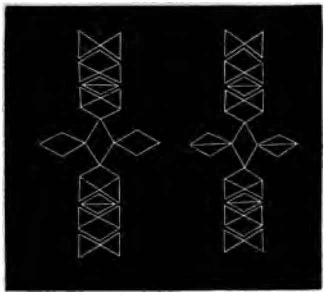


Hence a necessity for disposing of this exhausted matter elsewhere. So long, indeed, as between the two elements of N there is an atom of H only, we may still hope for the reproduction of *Am* and its further use in the animal; but when an atom of C gets between them, further use cannot be expected.

188. *Urea and Uric Acid.*—Among the many structures which the exhausted muscle element must give by its solution and degeneration, one presents itself as peculiarly stable and residuary, and such that we may look for it always. Where there is so much C, we cannot doubt but that sooner or later an atom of C will get between

the two atoms of N, and fill their cell, which is exactly a mould for an atom of C; and thus, just as a grand residuary species in inorganic nature, we have found OCO, so here we shall find NCN, though usually in union with H, giving NCNH (the melamine element), and analogous to COCH (the humic element), the weight of both the same, viz., the remarkable number 100 + 5. As then we found water low in the circle of life, when higher forms were degenerating, carrying an atom of HCOC on its pole (acetic), so here we may expect it to carry an atom of HNCN. The entire form will be NCNH*aq*AQ*aq*HNCN. This, when the particle of AQ is detached, will give 2(NCNH*aq*), which will make a step towards homopolarity, by becoming 2(HO,NCNH) which are together capable of constructing the fine form $\mathrm{ONCN}\frac{\mathrm{H}^3}{\mathrm{H}}\mathrm{NCNO} = \mathrm{C}^2\mathrm{H}^4\mathrm{N}^2\mathrm{O}^2$, (formula of Urea.)

But, in a region where C abounds to such an extent, and especially where, previous to ultimate transformation, C exists in union with H, according to the normal equatorial mode, viz., $\frac{\mathrm{C}^3}{\mathrm{H}}$, we may expect that this combination will often be found as the equatorial body, instead of $\frac{\mathrm{H}^3}{\mathrm{H}}$, that is, H^3 will often be replaced by C^3, giving $\mathrm{C}^5\mathrm{HN}^2\mathrm{O}^3$ (uric acid, Bensch), a much more stable form; and which nature gives both with an aqueous and an ammonia center, viz., $\mathrm{OH}\frac{aq^3}{aq}\mathrm{HO}$ and OHamHO, as also ONaO, etc. All which will be found on trial to agree with the chemical formulæ of the substances, the detail and accuracy of which, as determined in the laboratory, are, considering the darkness, wonderful.



Urea. Uric Acid.

190. *Hippuric or Zoo-tannic, and Benzoic Acids, etc.*—On inspecting the element of exhausted tissue, it shows itself to be composed of 2(COCHC) (see fig. 1, p. 92), carrying an atom of HO on one pole, and with the beautiful combination HCNHNCH in the centre. Supposing it to break up into these parts, and these to be reconstructed into a molecule of the order proper to them, we obtain a body composed of $\mathrm{C(COCHC)}^{10}\mathrm{C}$, with the nitrogenous part on the poles, $\mathrm{HCNHNCH,C}\left(\frac{\mathrm{CO}}{\mathrm{CHC}}\right)^{10}\mathrm{C,HCNHNCH} = 2(\mathrm{C}^{18}\mathrm{H}^8\mathrm{NO}^5) =$ Hippuric acid. There remain the elements of urea and carburetted hydrogen gas.

But such a form is very delicate, nor are its poles stable. They may be expected to go off, and (in nature) to resolve themselves into urea; and, with the assistance of CO going off from the body, into lactic acid; while the place of the nitrogenous polar matter will be occupied by the remaining CO, giving the benzoic in place of the hippuric acid. In the laboratory, instead of urea and lactic acid, two atoms of glycocoll (OCOCH*am*HCOCO) may be expected. The hippuric acid will doubtless detain an atom of *aq* on each pole. We may thus obtain from it

$$C^{36}H^{18}N^2O^{12} = \left\{\begin{array}{ll} C^2H^4N^2O^2 & \text{Urea.} \\ C^{28}H^{10}O^6 & \text{Benzoic acid.} \\ C^6H^4O^4 + aq & \text{Lactic acid.} \\ \hline C^{36}H^{18}N^2O^{12} & \text{Hippuric acid.} \end{array}\right.$$

Supposing, then, that no oxygen or other agent but water were supplied to the exhausted tissue, such would be one form of the discharge in equivalent substances.

191. *Creatine, Creatinine, Sarcosine, etc.*—But the tissue element must be subject to many changes, at least on the poles, while yet in the vernal or unused state. Its poles must be subject to manifold changes. And thus we shall have two classes of chemicals appearing, the one consisting of $OH\overset{C^3C^3}{\underset{am}{—}}HO$ (see fig. p. 97), with its newly acquired poles, the other of the matter rejected from the poles. Thus the most stable and ultimate combinations in zoo-chemistry we have seen to be NCNH (its dodecatom = $2(C^6H^6N^6$ = melamine), which, in nature, however, carries HO on the pole, giving HO,NCNH = $\frac{1}{2}(C^2H^4N^2O^2$ = urea). Now, with these, as also with merely HO as poles, and the same body, we may have from unchanged tissue

$$\begin{array}{rcl} \text{Pole.} & \text{Body.} & \text{Pole.} \\ \left.\begin{array}{r} HNCN,OH \\ HNCN,\quad \\ OH \end{array}\right\} & OH\overset{C^3C^8}{\underset{am}{—}}HO & \left\{\begin{array}{l} HO,NCNH \;\ldots\; C^8H^9N^3O^4 \text{ Creatine.} \\ \quad NCNH \;\ldots\; C^8H^7N^3O^2 \text{ Creatinine.} \\ HO \qquad\quad \ldots\; C^6H^7NO^4 \text{ Sarcosine.} \end{array}\right. \end{array}$$

192. *Sugar, Lactic Acid, Oxalic Acid, etc.*—The poles of the normal element of muscle are HCO and HOCO and OCO. Supposing them to be simply broken off, and then to aggregate into the molecular state, the first must give sugar, the first and second lactic acid, and the second and third oxalic acid. These also, therefore, we may expect in the juice of flesh, urine, and from degeneration of tissue generally.

193. *The Transformation of Tissue.*—But it is very unlike the economy of nature, that vast quantities of a substance, after serving a single purpose, should be of no further use, and be fit only for rejection from the system. Necessity, indeed, knows no law, and if the various molecular products that can result from the transformation of the tissue-element are all of an aqueous type, or soluble in water, so that their elimination, along with the water, which is ever leaving the system, is inevitable, then further inquiry is needless. It is well known, however, that besides the aqueous and soluble, there is also the oily or fatty, which is secure from solution in water. Let us then keep this in mind, as also the fact of respiration, which is constantly supplying oxygen to the exhausted tissue, and see what products we obtain from the tissue element under this point of view.

194. *Cerebrics, Oleophosphorics, etc.*—As the most perfect molecule, proper to this view, let us suppose the tissue-elements to form into a molecule round one of their H poles, giving an icosatom, and this by respiration, let us now testudinate, or encase in O. We thus obtain $(\mathrm{HOCOCHCHCNHNCHCHCOCO})^{20} = 20(\mathrm{C^8H^6NO^4}) = 120(\mathrm{CH}) + 40(\mathrm{OCO}) + 20\mathrm{N}$, that is, we have here abundance of matter, for fatty molecules with carb. acid for the poles. Now, if we take $\mathrm{OCO}\left(\frac{\mathrm{C}}{\mathrm{H}}\right)^{20}\mathrm{OCO}$, or $(\mathrm{OCO})^3\left(\begin{array}{c}\mathrm{CH}\\ \hline \mathrm{CH}\\ \hline \mathrm{CH}\end{array}\right)^{20}(\mathrm{OCO})^3$, or $\left(\begin{array}{c}\mathrm{CH}\\ \hline \mathrm{CH}\\ \hline \mathrm{CH}\end{array}\right)^{20}(\mathrm{OCO})^{12}\left(\begin{array}{c}\mathrm{CH}\\ \hline \mathrm{CH}\\ \hline \mathrm{CH}\end{array}\right)^{20}$, *i.e.*, carb. acid combined with the margaric radical, and to these add an atom of the urea element HNCNOH, and to a triatom add an atom of Ph, we obtain a combination which satisfies the conditions of the cerebric acid of the chemist, as analysed by Fremy, $W = 9050$.

Besides the genesis of such acid there would result only carb. acid and nitrogen, both of which could be exhaled.

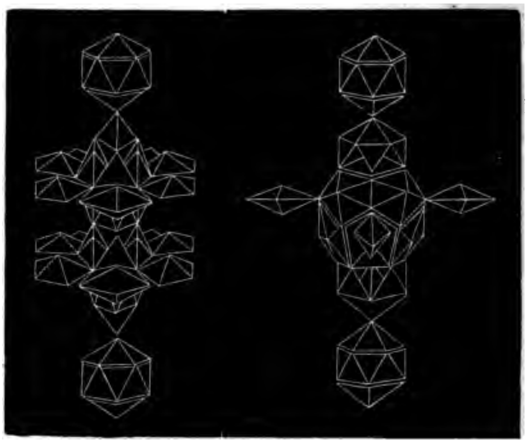
According to this view, the action of a muscle ought to tend to give volume to it (by the interposition of fatty particles in its tissue), as also organization and energy to the nervous system, which is required in order to the right use of the muscle, provided always that an abundant supply of oxygen and of fresh food is supplied to the system.

195. *Chitin.*—It would form a very expanded and solid element of cellulose, which might be expected in the animal kingdom where existing in the most close relations with the vegetable, if the body of the zoo-cellulose element, viz., COHamHOC ($= \mathrm{C^2H^5NO^2}$), instead of receiving its $\mathrm{C^3} + \mathrm{C^3}$, so as to give a simple element of zoo-cellulose, should receive $(\mathrm{COH}\overset{\mathrm{C3}}{\underset{aq}{—}}\mathrm{HOC})^3$ (see fig. 1, p. 90), that is, three elements of phyto-cellulose upon its equator. We should then have a zoo-phyto-cellulose, its elementary formula $\mathrm{C^{17}H^{14}NO^{11}}$, which is exactly C. Schmidt's formula for the cellulose forming the crusts of insects, etc., as also very nearly his view of its nature.

196. *Bile.*—And generally not only from the food, in consequence of the indigestibility of cellulose, but from the constructive power of life, we should expect a constant supply of the cellulose element in the animal system. Let it be reduced to the utmost, *i.e.*, charged with C and H instead of O, and we obtain $\mathrm{CH}\overset{\mathrm{C3}}{\underset{aq}{—}}\mathrm{HCH}$ (fig. 1, p. 93), forming an icosatom; to each of which giving the same poles as to hippuric acid, we obtain $\mathrm{HCNHNCH}(\mathrm{CH}\overset{\mathrm{C^3}}{\underset{aq}{—}}\mathrm{HCH})^{20}\mathrm{HCNHNCH} = 2(\mathrm{C^{52}H^{43}NO^{10}})$. Omitting the nitrogeneous poles $= 2(\mathrm{C^{50}H^{40}O^{10}})$, in both which we see material for the biliary bodies, as also a reason why the hepatic system should be so partially developed in insects, since, according to this view, their dermal system replaces it.

197. *Colorifics.*—The action of the light of the sun being purely

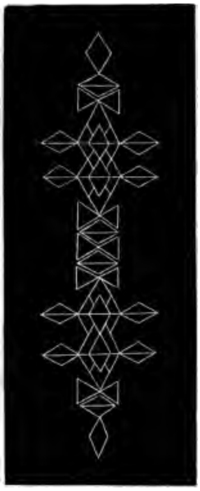
physical, goes on reducing carb. acid, and giving more and more C, while the current of life continues. Hence, what may be called a hypertrophy of cellulose, giving generally when it has been completed $\frac{C^6}{aq}$ and $\frac{C^6C^6}{am}$, instead of $\frac{C^3}{aq}$ and $\frac{C^3C^3}{am}$. But as soon as we have this state of things, dimorphism attaches to the species, as has been already shown. A molecule, of which C^{12} shall be the radical, is imminent; and to this, when duly supported, the beautiful colours of nature seem to be mainly owing. As an example, we may take a species whose body is *Am*, though there are many, as is well known, whose body is *aq* only. In its vernal state (1) we have $COCH\frac{C^6C^6}{am}HCOC$. In its autumnal, stable or laboratory form (2) it is $COCN\frac{H^5}{C^{12}}NCOC$. Both give as the elementary formula $C^{16}H^5NO^2$ = indigo, whose alternate colourlessness and colour are thus explained.



1. Indigo. 2.

198. *The Conjugation of the Elements of Tissue.*—As has been shown in reference to phyto-cellulose (p. 91), when these forms are in the course of development, and as soon as a single atom of C has gained possession of the pole of some individuals, while all the others have O poles, they will couple, and thus we shall have a double form in reference to the least carbonized variety; the coupling being effected by an atom of O in reference to the most fully carbonized variety. To this also it seems right, according to analogy, to give ultimately an atom of H to each pole. We then obtain an organic element which presents the highest claims to our regard, possessing, as it does, a symmetrical balance of parts, and of metallic and non-metallic, which seem to place it as an ultimate product in organic synthesis, and also one which shall possess all the stability of which such delicately constructed combinations can be capable.

In its most rudimentary, or residuary state, it gives



$$\mathrm{OH}\overset{C^8C^3}{\underset{am}{\text{———}}}\mathrm{HOCOH}\overset{C^3C^8}{\underset{am}{\text{———}}}\mathrm{HO}$$

C^{13}	390	52·7
H^{10}	50	6·8
N^2	140	18·8
O^4	160	21·7
	740	

In its most perfect state it gives

$$\mathrm{HCOH}\overset{C^3C^3}{\underset{am}{\text{———}}}\mathrm{HOCOCOH}\overset{C^8C^2}{\underset{am}{\text{———}}}\mathrm{HOCH}.$$

C^{16}	480	54·6
H^{12}	60	6·8
N^2	140	15·9
O^5	200	22·7
	880	

199. *Albumine, etc.*—Of the latter most mature body, the most perfect molecule must be an icosatom. And marking its poles in the current of life, not by H and O, which are too small, but by Ph and S^4, we obtain the following very interesting result,

$$S^4(\mathrm{HCOH}\overset{C^8C^8}{\underset{am}{\text{———}}}\mathrm{HOCOCOH}\overset{C^8C^8}{\underset{am}{\text{———}}}\mathrm{HOCH})^{20}S^4\mathrm{Ph}.$$

=

			Mulder.
C^{320}	9600	53·333	53·5
H^{240}	1200	6·666	7·0
N^{40}	2800	15·555	15·5
O^{100}	4000	22·222	22·0
$2S^4$	320	1·555	1·6
Ph	80	·488	·4
	18000	100·000	100·0

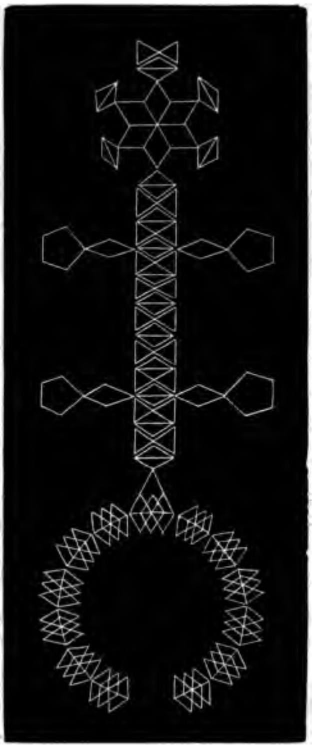
Albumine.*

---

* The weight of this molecule is that of ten particles of basic or organic water. And it must be regarded when entering into living formulas, as also encased in AQ, a particle of water to each element, as is the case with all organic elements whatever. On the oxygen scale it is $\frac{100 \times 18000}{40} = 2 \times 22500$, Mulder having calculated from its combination with the oxide of lead, the equivalent of albumine to be 22483·9, a difference of $\frac{1}{1400}$. It also agrees well with the more recent formula of Leiberkühn, the latter being about $\frac{1}{9}$ lighter. It is, however, pleasing to observe how the conflicting formula of the proteins or peptones are harmonized by remembering that where only one pole is terminated by H, there may be the dodecatom as well as the icosatom and tetratom.

200. *The Elementary Symmetry of Zoo-organic Forms.*—All the tissue molecules noticed in the preceding pages, whose bodies consist not of *aq* but *am* (see fig. p. 97, etc.), present what may be called a thoracic and a pelvic region, each carrying three atoms of carbon, of which, when the form acquires maturity by the transformation of the axis Am into H^3N, one enters the axis; meanwhile H appears, in order to form members by which the other two atoms of carbon shall be attached to that axis, their angles determining the number 5 as that which is normal to the extremities when fully developed and matured, while H will determine to the number 3.

But if framed for life and activity, the axis which, in consequence of the peculiar forms of C and O and N, must tend to be a vertebral column, must be heteropolar, as for instance, composed of highly reduced matter (fatty, cerebral) flowing upwards to one extremity, and of unreduced (aqueous) matter flowing towards the other extremity. Of this merest notice of the highest step in physics, the accompanying diagram may serve as a memorandum. But a diagram of an atom of bone earth would do. Also see silica, page 63, etc.



[illegible]